SCIENTIFIC AMERICAN

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TELEMETER SYSTEM.

The uses to which the telemeter may be applied are so numerous and so varied as to render it impossible to describe them all in detail within the limits of a single newspaper article. Some of the more prominent uses to which this instrument is applied are the transmission to one or more distant points of the indications of thermometers, barometers, and pressure gauges; also for indicating at a distant point the height of water or oil in open or closed tanks, or the height of gas holders.

To accomplish the transmission of these indications two instruments are required, one for transmitting and the other for receiving and recording, the two instruments being connected by wires so as to form complete electrical circuits, which are supplied with a current from a suitable open circuit battery. A number of receiving instruments may be used in the same circuit.

The telemeter system has been in practical operation for a number of years, proving itself to be accurate and reliable in all of its applications. It has recently been much simplified and improved, both mechanically and electrically.

One of the uses to which the telemeter has been applied is that of transmitting time from a master clock to a series of dials. In this particular application its merits have been shown to the best advantage. As a

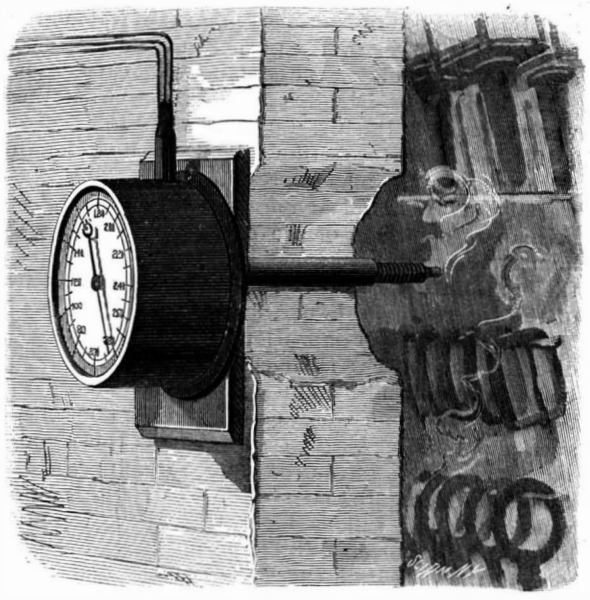

Fig. 6.—TELE-THERMOMETER.

time system, it has proved accurate and in every way desirable.

The transmitting instrument is substantially the same for all uses, and the receiving instrument is, in part, a copy of the transmitter, with the addition in some cases of apparatus for making a permanent record. The receiver is also provided with an alarm for giving notice when the prescribed maximum or minimum indication is reached. As indicated by the illustrations, the mechanism of the instrument is very simple and of such a character as to require no attention after being placed in position for use.

Without going minutely into detail, the operation of the apparatus may be briefly described as follows:

The transmitter has a step-by-step motion, which is provided with two magnets, one for turning the step-by-step motion in one direction and the other for turning it in the opposite direction. These magnets are in separate local circuits, each of which is provided with an auxiliary armature and contact closer, so that when the current is supplied to the magnet its armature will be attracted, and through the medium of the pallets and motor wheel will rotate the index arbor. The transmitting instrument with the dial removed is represented in Fig. 1.

The apparatus thus described appears on the front of the base plate beneath the glass of the case. The

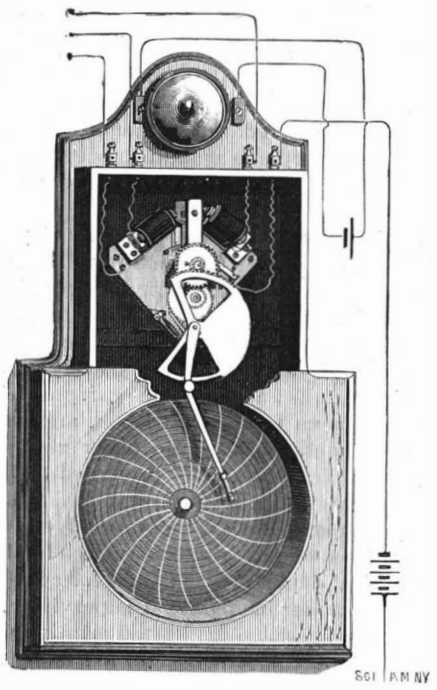

Fig. 2.—RECORDING RECEIVER.

complete mechanism is here shown, with its electrical connections. The thermometer, pressure gauge, or other primary instrument whose indications are required is placed back of the transmitting mechanism in such relation to the latter that the movements of its hand will close the circuit-controlling devices.

The receiver is provided with step-by-step mechanism like that of the transmitter, but the contact makers are omitted. Each magnet of the receiver is connected by a line wire with the circuit closer of the corresponding magnet of the transmitter, the latter acting as a relay for closing the circuit through the receiver, so that every impulse of either of the magnets of the transmitter is repeated by the corresponding magnet of the receiver, thus turning the index arbor of the receiver synchronously with the index arbor of the transmitter. By this action of either of the magnets of the receiver the circuit is broken and the mechanism of both transmitter and receiver is moved one step, and the instruments are both ready for a new impulse in either direction from the primary instrument.

When it is desired to preserve a record of the indications of the receiving instrument, a toothed sector is attached to a shaft journaled in the frame of the instrument and arranged to be engaged by a pinion on the index arbor. This toothed sector carries an arm provided at its free end with a pen which rests upon a graduated paper dial carried by a clock movement arranged in the lower part of the receiver case, as shown in Fig. 2. These graduated dials and the clocks to which they are attached are adapted to either daily or weekly records, as desired. A part of a day's record is shown in Fig. 3. The circuits are shown diagrammatically in Fig. 5.

These are described as follows:

a, hand carried by thermometer, and arranged to give the initial contact. a', a'', insulated spring-supported contact points. a^1, wire connecting contact point, a', to screw, 2, and magnet, M^2. a^2, wire connecting contact point, a'', to screw, 1, and magnet, M'. 1, 2, contact screws insulated from the base of the transmitter. 3, 4, contact springs fastened to initial armature. 5, 6, light armatures connected together, pivoted between the plates of the transmitter, and normally held in the central position, so as to bear on the faces of their respective magnets. 7, 8, insulated contact screws. 9, 10, contact springs fastened to the driving armatures and electrically connected to the base of the transmitter. 11, 12, armatures carried by the pallet lever for driving the machinery of the instrument. 13, circuit-breaking lever connected electrically with the plates of the instrument. 14, spring of the circuit breaker insulated from the base of the receiver and connected electrically to one pole of the battery, B.

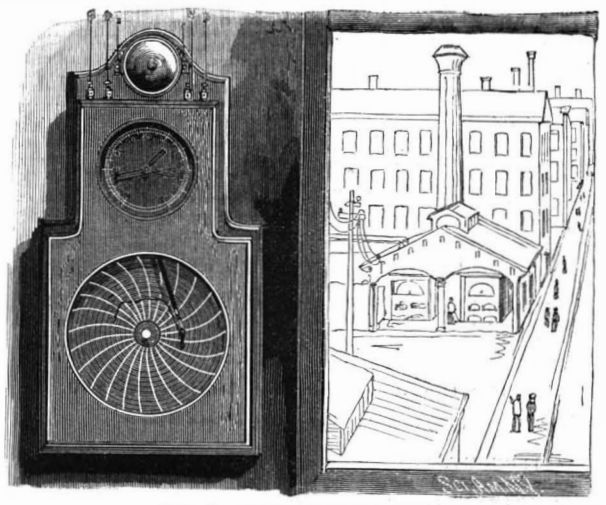

Fig. 7.—TELE-MANOMETER.

15, lever for holding the pallets in the central position. 16, pawl for holding the driving wheel, W, in its normal position. 17, 18, pins in the fork to act upon the incline of the lever, 15. W, driving wheel pivoted between the plates and used in all instruments. L^1, line connecting magnets, M^1 and M^2, of the transmitter to the base of the receiver. L^2, line connecting insulated part, 7, of transmitter with magnet No. 3 of the receiver. L^3, line connecting insulated part 8 of transmitter with magnet No. 4 of the receiver. 4 B, line connecting the base of the transmitter with one pole of the battery, B. M^5, M^6, magnets of intermediate receiver connected to lines connected with corresponding magnets of the receivers. The operation of the apparatus is as follows: The hand, a, which is always in connection with the battery, moves and makes contact with the commutator point, a'', thus closing the circuit. The current passes through the line, 4 B, thermometer hand, a, commutator, a'', wire, a', and magnet, M', then from the transmitter through line, L', to the base of the receiver; from thence through lever, 13, and spring, 14, to the battery. The light armature, 5, will be attracted by a feeble current, bringing the spring, 3, in contact with screw, 1, shunting the commutator, which will be moved away from its contact with the hand by the mechanism of the instrument. The armature, 11, being attracted by magnet, M', brings the spring, 9, in contact with the screw, 7, dividing

(Continued on page 66.)

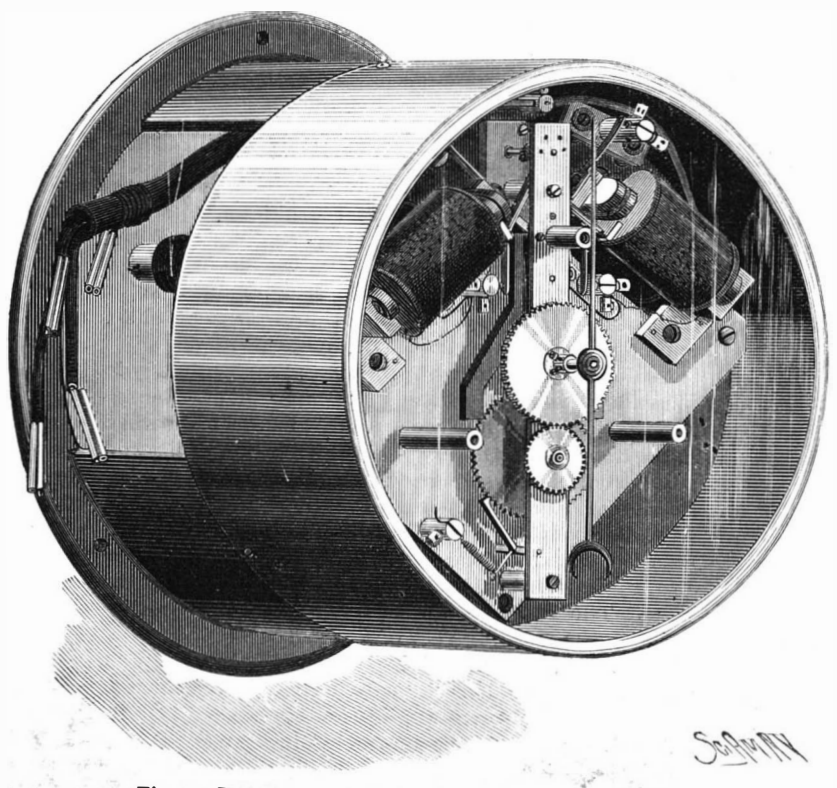

Fig. 1.—TELEMETER SYSTEM—THE TRANSMITTER.

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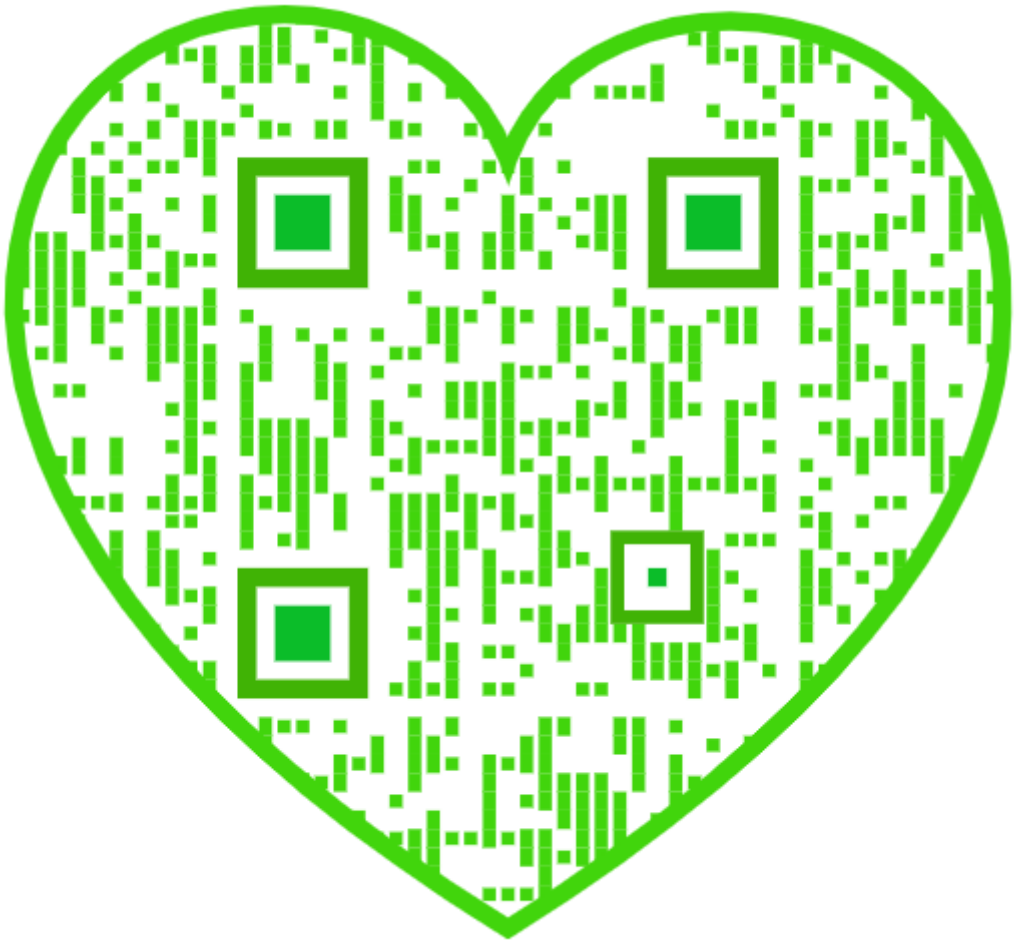

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WORKING FOR KNOWLEDGE.

James G. Blaine, Jr., son of the Secretary of State, is determined to become a practical railroad man, and is not afraid to do any sort of work necessary to acquire actual knowledge of the business. Some time ago, he entered the Maine Central Railroad's machine shops at Waterville, under the immediate instruction of the most skilled mechanics in the employ of that great corporation. After mastering the business in its every detail, the young man has now made a new departure by entering the cab of a locomotive and commencing to "fire." He has been given a position on the fast express train between Bangor and Bar Harbor.

The mercury was away up among the nineties when young Blaine made his first appearance on the engine. He was dressed in the ordinary coarse blue drilled overalls and jumper of a railroad fireman. His face had been changed by black coal dust and perspiration until his countenance was hardly recognizable. His hands were black and blistered, but he was sticking manfully to his task, and every one around the depot was crowding to the forward end of the train to get a glimpse of him.

This reminds us of the early career of young Mr. Gilbert Jones, one of the proprietors of the *New York Times*. In order to become practically acquainted with the construction and operation of machinery, he enlisted several years ago as a workman in the Novelty Iron Works of this city. At six o'clock every morning he donned his overalls and left home carrying his dinner pail, trudged down to the East River, and performed his full day's work among the other men. He was active, quick to learn, and was promoted to be boss of a gang employed to put on board and connect the machinery of steamships. The knowledge thus gained has always been of the greatest service to Mr. Jones. The mechanical department of the *Times* has for several years been under his personal supervision. It embraces many costly and complicated printing machines, but by his intelligent direction all are made to run as smooth as clockwork.

THE NEW YORK WATER SUPPLY—HOW THE PEOPLE SUFFER FROM LACK OF PRESSURE.

The Croton gravity system of 1837 has in recent years lost the greater part of its hydraulic pressure in consequence of the extension of service mains. The apparent diminishment of pressure has been greater than could be ascribed to this cause alone, and is accounted for by the general adoption of the elevator system.

The surface area made available, or which may be said to have been added to Manhattan Island, through the means of the elevator is one-third of the whole, or about 4,500 acres. The height of this non-terrestrial acquisition of the property owners may be put down as averaging 70 feet above the ground levels of the city.

Accordingly, two features of importance in any scheme for an additional supply were to overcome the loss of head experienced from friction and to reach the lofty modern city with water under a head of at least 150 feet. The first of these requirements was met by the fallacious idea that if the aqueduct were doubled in size, the baffling effect of friction would disappear, and the second, presumably because of its celestial aspect, was defiantly ignored.

Now, to what extent are the people doing the work of the municipal government? And what expenses are incurred through lack of provision in the new project for plenty of water under adequate head?

In the first place, the property owners are pumping five-eighths of the delivery, or more than 62,000,000 gallons a day. To do this work, it is estimated, they have invested in pumps and machinery of various kinds about $6,000,000, and they are under an expense for labor and fuel of $15 per million gallons. A better conception of what is thus done collectively will be had when we say that the volume of water daily raised by pumps is equivalent in weight to 260,000 tons.

If the city had three pumping stations with stand pipes, this same volume of water could be raised 100 feet for eight dollars and a half per million gallons. Whether the cost at present is greater or less than the above is of little pertinence. The fact remains that it is the duty of the city to furnish the water to all alike, and not discriminate against the majority.

Again, the deficiency of pressure operates in a way to increase the expense of the Fire Department—the engines having to supply the force that has been absorbed in friction; for as the town expands both laterally and vertically, the pressure grows more feeble, and, in a degree proportional to the high buildings, less available. The disadvantage of this state of things to the taxpayers is shown by the high cost of maintenance of the Fire Department and the high rate of increase of the same. The expenses for 1889 were $2,136,043—an increase over preceding year of $159,551.

Then, too, the actual loss of property by fire is greater than would be the case if there were sufficient head to permit prompt application of streams.

Another result is the refusal of insurance. So apparent is the inadequacy of the supply that $150,000,000 worth of property in the city is now unprotected by policies.

In a large city there are besides many ways of utilizing small power, such as would be afforded by water under reasonable pressure, and various kinds of manufacture are better fostered by a quick and abundant flow than by a scant and intermittent one.

All these disadvantages of an ineffectual gravity supply combine to make New York an expensive place for property owners. So far as the question of pumping is concerned, the tendency will be to make it still more so, since improvement is more general on high than on low levels and since the new structures are invariably several stories higher than the ones they replace. For this reason it cannot be claimed that the proportion of water pumped will remain at five-eighths of the delivery.

The fact that the new aqueduct has been built to withstand no pressure shows that the *builders* never dreamed of procuring water from an elevated watershed. So the most obvious sequel to this capacious conduit is a number of pumping stations; but in the contemplation of such a tempting local job as this would be, the people are confronted with the certain failure of the Croton watershed to afford the volume demanded and the danger of the quality of the water growing inferior when the storage reaches three times its present volume.

What the city will have to come to is an auxiliary supply from an elevated watershed. This is manifest destiny, and will shorten the road to imperial destiny.

The International Exposition of 1892 in the City of New York.

The year 1892 will be memorable as the four hundredth anniversary of the discovery of America by Christopher Columbus. To fittingly celebrate the birth of the new land and its introduction to civilization, it has been decided to hold an exposition. New York has been selected as the site. The matter was definitely settled at a meeting held in the Governor's room in the City Hall of this city on Thursday, July 25th. It was called by Mayor Grant, who issued personal invitation to representatives of the commercial and business life of New York, requesting them to attend at his office for the purpose of considering the advisability of holding the contemplated exposition.

The invitations, in spite of the absence of many who were included in the list, were responded to by enough to fill the room to overflowing. Some two hundred were present, the mayor presiding. The project was warmly received, and at once the mayor was elected permanent chairman of the committee, and Mr. William McM. Speer permanent secretary. The name of the organization was selected. It is "The Committee of the International Exposition."

The question of organization of sub-committees was discussed, and after a sufficient deliberation, four such bodies were established, one on permanent organization, one on finance, one on legislation, and one on sites and buildings. The selection of the members was by resolution put in the hands of the mayor.

This marks the first step in the work of establishing what should and will be the greatest exhibition in the history of the world. While the meeting was in progress at the City Hall, the Chamber of Commerce of the city of New York held a separate meeting indorsing the project, and added the weight of their influence to the movement.

It is unnecessary to mention the names of the participators. It is sufficient to say that at both meetings commerce, official and political life, and the law were present in the persons of their leading members. The occasion will be a historical one, and the date of the holding of the two meetings will be a day to be long remembered in view of the great results that will inevitably follow within the next three years.

Nitrates in Rain Water.

One of the stations of observation selected by the authors is at Caracas (Venezuela), in 10° 3′ N. lat., and at the elevation of 922 meters. The mean temperature is 21·8°, the rainfall is irregular, and the storms severe and frequent. The observations extend over two years, and refer to 121 samples. The general mean of nitric acid was 2·23 m.grms. per liter. On one occasion it rose to 16·25 m.grms., and on another it was as low as 0·20 m.grm. On the contrary, at Liebfrauenberg, in Alsace, Boussingault found a mean of only 0·18 m.grm. nitric acid per liter, and at Rothamsted Messrs. Lawes and Gilbert obtained a mean of 0·42 m.grm. If we compare the total quantity of nitric acid thus brought down to the ground yearly, the difference appears still greater, as in tropical countries the annual depth of rain is generally greater than in temperate climates. At Caracas the rainfall is about 1 meter. The quantity of nitrogen brought to the soil in the state of nitrate is 5·782 kilos. per hectare, while in Alsace it is only 0·330 kilo. and at Rothamsted 0·830 kilo. In the Island Reunion the mean nitric acid per liter of rain is 2·67 m.grms., or, taking the rainfall at 1 meter, 6·93 kilos. of nitric nitrogen per hectare. In such climates the rainfall alone supplies a nitrogenous manuring equal to about 50 kilos. of nitrate of soda yearly.—*A. Muntz and V. Marcano.*

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Execution of Criminals by Electricity.

A murderer in New York named Kemmler has been sentenced to death, and his execution will be the first under the newly enacted law by which electricity is substituted for the rope, hanging being abolished. The lawyers for the condemned man are making strenuous efforts to save the criminal on the alleged ground that the new mode of causing death is experimental, is a failure, is simply a device for inflicting grievous bodily torture, not a legitimate mode of execution, and therefore should not be applied or tried upon the body of their client.

A reference commission has been authorized by the courts to examine witnesses and take the testimony of experts as to the probable value of the electrical machines as instruments for destroying human life. Much evidence has been presented on behalf of the doomed man. Several experts have testified that the action of the proposed electrical current upon the human system was uncertain; that it might or might not kill; but in any case would produce the most excruciating pains. The expert witnesses for the State testify directly to the contrary. Among the latter Mr. Thomas A. Edison appeared. His evidence was clear and straightforward. The following is an abstract:

"What is your calling or profession?"

"Inventor," briefly replied the witness.

"Have you devoted a great deal of attention to the subject of electricity?"

"Yes."

"How long have you been engaged in the work of an inventor or electrician?"

"Twenty-six years." In reply to questions he said he was familiar with the various dynamos and their construction, and that they all generated either a continuous or an alternating current.

"A continuous current," he said, "is one that flows like water through a pipe. An alternating current is the same as if the same body of water was allowed to flow through the pipe in one direction for a given time and then its direction reversed for a given time."

The witness said he had been present when measurements were made in his laboratory to determine the resistance of human beings. Two hundred and fifty persons were measured, and their average resistance was 1,000 ohms, the highest being 1,800 ohms and the lowest 660.

"Will you describe the method of the application of your tests?" Mr. Poste asked.

"We took two battery jars about seven inches in diameter and ten inches high, and put in each jar a plate of copper. In the jar we put water with a 10 per cent solution of caustic potash. The parties we measured plunged their hands into the liquid so that the ends of their fingers touched the bottom of the jars. After waiting thirty seconds the measurement was taken. No one could go above eight volts."

"Where, in your opinion, is the major part of the resistance located?"

"I should say 15 per cent at the point of contact. The balance in the body."

"What is the law that governs the passage of an electric current, when several paths of varying resistance are offered to it?"

"It divides in proportion to the resistance encountered."

"Please explain the burning effects sometimes produced in the case of contact with an electric wire."

"It is due to bad contact and the difference in resistance between the wire and the flesh."

"In your judgment can an artificial electric current be generated and applied in such a manner as to produce death in human beings in every case?"

"Yes."

"Instantly?"

"Yes." He advised placing the culprit's hands in a jar of water diluted with caustic potash and connecting the electrodes therewith, and he said 1,000 volts of alternating current would surely produce painless death instantaneously. He did not think so small a continuous current would, although by mechanically intermitting the continuous current it could be made very deadly.

Mr. Cockran, attorney for the prisoner, in his cross-examination laid much stress upon Mr. Edison's views as to the resistance of human beings.

"Did you make the experiments on men which you have mentioned with a view to ascertaining just how to measure the resistance of Kemmler and find out how men may differ in the matter of resistance?" asked Mr. Cockran.

"I did. I made the experiments day before yesterday," Mr. Edison replied.

"And you found out there were different degrees of resistance in different men?"

"Yes; but that does not mean that the same current would not kill all the men."

"What would be the effect of the current on Kemmler in case the current was applied for five or six minutes? Would he not be carbonized?"

"No; he would be mummyized. All the water in his body would evaporate in five or six minutes."

With what he had found to be the average resistance of the human body, the witness said that 1,000 volts would give a man an ampere of current, which is ten times as much as any man needs to kill him.

In reply to a question by the referee he said there was an alternating dynamo in London that generated a 10,000 volt current, and he considered it safe to double up dynamos to increase the current for use in executions.

"This is your belief, not from knowledge?" Mr. Cockran asked.

"From belief. I never killed anybody," the witness quietly replied.

Visit of American Workingmen to Paris.

On Wednesday, July 24, the American Workingmen's Expedition, sent by the Scripps League, set sail for Europe, to visit the Paris exposition and incidentally to inspect other features of interest in England as well as France. When the Centennial was in progress in this country, representative French workingmen visited it under the auspices of their government, and during the present year England has sent 100 men of this class to the Paris exposition. In order that America might not be behindhand, the Scripps League of American newspapers, including the *News* of Detroit, the *Press* of Cleveland, the *Post* of Cincinnati, the *Chronicle* of St. Louis, the *Echo* and the *Sunday News* of Detroit, organized this expedition. It includes some fifty representatives of many trades, among whom are four women. Their expenses are paid for them, and they are free each to study the progress of their own special technical art at the cost of the league. Thus they are at once a representation of American trades and a tribute to the progressive instincts and liberality of American journalists.

A very neat pamphlet has been issued *apropos* of their visit. It describes the origin of the affair, the programme, with brief biographical notes and portraits of the tourists. They are in many cases Knights of Labor or figure in trades unions and workingmen's associations. This gives a character to the party which it would lack were the participants present only in individual capacities. Without flattery it may be said that this body of trades people is in every way, by appearance as well as by record, well fitted to produce a favorable impression abroad, and to show how dignified are the positions to be attained by skilled manual workers in this country.

Is Ice Water a Healthy Drink?

In the opinion of the editor of the *Sanitary Volunteer*, the official organ of the New Hampshire board of health, there is a great deal of sentiment and many opinions regarding the use of ice water that vanish when the light of reason and experience is turned upon them. The fact is that ice water, drank slowly and in moderate quantities, constitutes a healthful and invigorating drink. There is no doubt that ice is a great sanitary agent, and every family ought to be provided with it during the warmer months of the year. It is true that the inordinate use of ice water, or its use under some special conditions and circumstances, is attended with great danger; so is the improper use of any other drink or food. The assumption that iced water is dangerous, and that iced tea, or iced coffee, or iced lemonade is a harmless substitute, is simply a delusion. As the source of danger feared by some is the degree of cold, we fail to see clearly how flavor modifies the effect of temperature. There are individuals, undoubtedly, who cannot drink ice water without injury, and who ought never to use it, but to a great majority of persons it is refreshing and healthful. Its use, temperate and discreet, is in no way to be condemned, which cannot be said of some of its substitutes.—*The Sanitary News.*

How to Lay Floors.

After the joist has been jointed with the fore plane or jointer and spaced on the wall, then place stay lath near where the bridging should be. One man should sight the joist straight while another man nails the stay lath down (temporary, of course). The joist should be beveled up with straight edge at wall bearings. Now when the building is ready for floors we will cut one course of boards the length of building, then strike a line on the joist to straighten the first course by next laying the boards to the line, and with the *groove* edge to the wall, and nail down on groove edge through board, also nail *over* the *tongue* at an angle of 65°. If there are any irregularities in the wall, support the starting course with some shingles where it is away from the wall, and after the floor is complete they can be taken out. Proceed with next course, drive up the board with a piece of hard wood laid against the tongue so as not to mar it, and nail over the tongue only as before. Continue so within six or eight inches of bridging line, then bridge the joist, take off stay lath, and proceed with flooring as before. By laying floor up to the bridging line brings all joists up even, if there should be any slight unevenness in them, and the bridging then holds them rigid.—*A. Chip.*

The Morphia Fiend.

Under this very suggestive heading, a writer in the *Pall Mall Gazette* gives us a very graphic description of the morphia habit, which is apparently growing among the community at an alarming rate, and causing devastation to body and soul in a degree which can only be estimated and realized by those who have the misfortune to witness its effects upon the unfortunate creatures addicted to its use.

Imagine (says the writer) an instrument about the size of a pencil case, constructed somewhat after the model of a wasp's sting, and fitting into a tiny case which will go with ease in the muff, the waistcoat pocket, or the bosom of the dress. The instrument itself may be of gold, and the case may be fashioned like a jeweled scent bottle or other trinket, and hang suspended from a golden chatelaine with the most innocuous air. This is the injector, and a slight punctuation of the skin with the waspish point is sufficient to enable the required quantity of the magic liquid to be discharged into the system. Nor is the term magic an exaggeration, for not more magical was the effect produced by the pills which the travelers swallowed in the cave of Monte Cristo than that which results from the injection of morphia. It must be, however, observed here that there are three distinct stages of morphia absorption, all of them brief in duration, the last one briefest of all.

During the first stage the results are purely pleasurable, they bring a draught of fresh life into jaded limbs. The faculties receive a sudden stimulus, the callous sense of pleasure is sensitive once more, the vision of the world cast on the mental eye is drawn in rosy lines, the whole appreciation of things earthly is that of one who is prepared to drain the cup of life to the bottom and enjoy it to the full. The subject lives in a glamorous sense of vague happiness, her half-closed eyes reveal the state of exquisite lassitude which laps her limbs, she feels that her one enemy is exertion, she is too happy to trouble about anything, all that she asks is that her friends should be happy around her, even as she is happy. Her hold on eternity loosens as her desire for it decreases. "Why take thought for the morrow?" would run her new reading of the text, "Sufficient for the day is the happiness thereof."

In time, however, a change comes o'er the spirit of this rose-colored dream. Its continuity becomes broken by dreadful intervals of reaction, during which the victim is oppressed by all the horrors of intense melancholy and weakness, and from which relief can only be obtained by continual repetition of the process of injection. The baneful habit acquires a firmer hold by counter-irritations. It is so easy to drive away the blue devils that are making themselves apparent, to check the reaction which has begun to set in, to change the dark shadows which are clouding over the vision of life into the rainbow hues of the morning, to transform the victim of melancholy, the prospective suicide, into the laughing child of pleasure whose creed is that of the half-pagan Leo X., "Let us enjoy what God has given us." So easy—but only by constant use of the fatal drug; and as the former slight injections have lost their power, larger doses of the stimulant must be launched into the system before the desired effect can be produced.

The result, however, of the increase of the quantity injected is to develop the feeling of lassitude until in time—such a brief period!—it completely overpowers the senses, and the victim becomes practically lost to the world. She lives in a rose-colored world of her own, in which happiness reigns supreme and which she would not leave if she could; for her re-entry into the life she has forsaken can only be accomplished by passing through a period of intense mental and bodily torture. She knows that she is slowly dying, that she is slipping to extinction in a soulless, mechanical way, like a clock which inevitably runs down when its motive power is exhausted; but her appreciation of abstract ideas has become blurred; life has lost its meaning, death its terrors. Better it is, she thinks, so far as she compares her condition at all, to fade slowly and happily out of life without a thought or a care to checker the last brief period of existence than to face the struggle by which alone she could be saved. Indeed, it is doubtful whether, even if she could be kept by force from the use of the stimulant, she would not feel its loss so acutely that she would die in horrible agonies almost as quickly.

By a curious perversion, therefore, of the original object, it has been reserved for modern science to bring into existence and use the dream of the ancient poets—the drug which conferred happiness uncheckered and unalloyed. Were it possible, however, to analyze the mental condition of the victim during the hours of reaction, it might be possible to realize also the tortures of the damned in the mediæval hell.

THE Supreme Court has repeatedly said that a man's right under his patent for an invention is as absolute as under a patent for lands, and no one would say that one should lose the right to his house because some one else saw fit to take possession of it against his will.

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TELEMETER SYSTEM.

(*Continued from first page.*)

the current which passes through the line, L^2, magnets, M^5, of the intermediate magnet, M^4, of the receiver to the base of both instruments; through the lever, 13, and spring, 14, to the battery. The armature of the magnet, M^3, is attracted, carrying the fork or pallets which propel the wheel, W, and also by means of the pin, 18, pushes lever, 15, so that it strikes the adjustable screw in the lever, 13, throwing it away from its contact with spring, 14, breaking the circuit and allowing the instruments to return to their normal position.

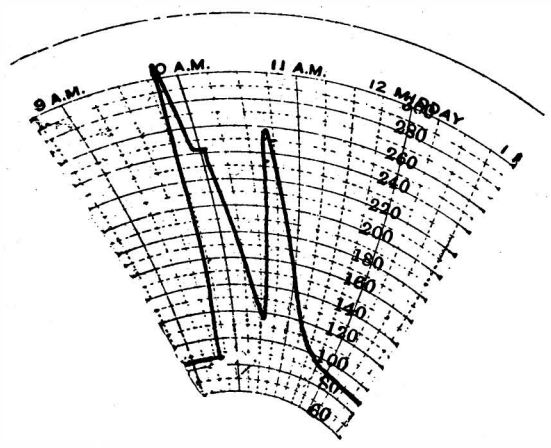


Fig. 3.—PART OF A DAY'S RECORD.

In Fig. 6 is shown the application of the tele-thermometer to a japanning oven. The thermometer spiral extends into the oven, and its shaft passes through a tube to a transmitting instrument attached to the outer surface of the oven wall. This tele-thermometer with ordinary pipe fittings can be attached to any boiler tank or pipe to show the temperature of the liquid, gas, or steam contained therein. Wires leading out of the top of the instrument extend to a receiver at a distant station.

In Fig. 7 is shown one of the important applications of the telemeter. The transmitting steam gauge upon the boiler in the distant boiler house sends its indications through the wires to the receiving instrument, where it indicates the boiler pressure and also makes a continuous and accurate record, the receiver being removed to a safe distance from the boiler house, where the records will be out of danger of destruction by an explosion, should one occur. It will be noticed that in this, as in the other receiving instruments, an alarm bell is shown which is set in operation by an extreme movement of the index in one direction or the other.

A similar application of the telemeter is shown in Fig. 8. In this case the transmitting instrument is connected with a gas holder, and the indications of the height of the gas holder are transmitted to the receiver at the distant station. Here, also, a record is made from which at any time the cubical contents of the holder may be determined.

In Fig. 9 is shown a tele-thermometer located in a mine, the receiver being above ground; and in Fig. 10 is represented a water level indicator capable of giving the height of the water in reservoirs, dams, and streams, and showing the rise and fall of tides at distant points. This application of the telemeter will be readily understood from the illustrations.

It is obvious that there are various other uses to which these instruments may be applied. For instance, they will prove of great value in connection with meteorological instruments, transmitting dynamometers, speed indicators, etc. They may also be utilized to advantage for indicating the height of water or oil in boilers or tanks under pressure. They may also be employed as deep-sea thermometers and for indicating the temperature of the sea in the track of seagoing vessels, keeping a record of the temperature during their voyage.

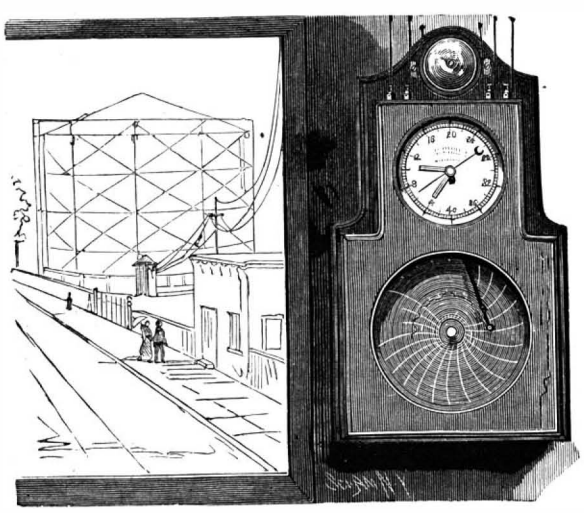


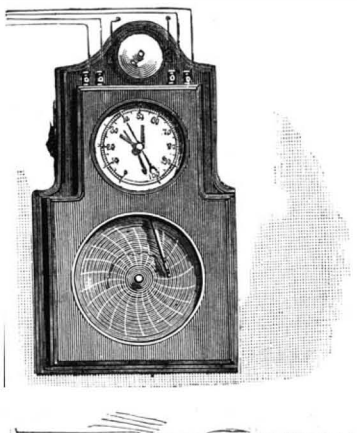
Fig. 8.—TELEMETER APPLIED TO GAS HOLDER.

These instruments are manufactured by the Standard Thermometer Company, of Peabody, Mass.

The Use of Dogs in War and in the Army.

A recent paper read before the Royal United Service Institution of England was devoted to a subject which to a certain extent is a novel one, the employment of dogs for military purposes. While it is by no means difficult to cite instances from history of the utility of dogs in the service of individual masters, in the averting of surprises, etc., in similar emergencies, yet the systematic enrollment of the animal in the ranks of a modern army is to a great extent a novelty. The dog possesses qualities which, if properly directed, would give him much utility. His speed, small size, tendency to recognize a master, and capability of distinguishing between a friend and foe, are among these qualities.

As a sentry he could be employed to supplement the human soldier. The author of the paper we have alluded to considers that with a dog to help them, sentries need not be posted within 300 yards of each other. The scent and acute powers of hearing of the dog, he considers, would cover efficiently such an interval. The role of sentry is an old one for the dog, as he figures as such in country houses everywhere. Turning from so obvious a use, his scouting powers may be found available. A body of men advancing in front of an army could, by the assistance of trained dogs, examine every suspicious locality that might be the site of an ambuscade. The experience of hunters in beating for game shows how thoroughly ground can be covered by these means. The finding of the larger and more conspicuous human game would try the sagacity of the dog much less than would the discovery of an inconspicuous game bird. It is suggested also that the main army could employ them to advantage in reconnoitering on the flanks and in the rear.



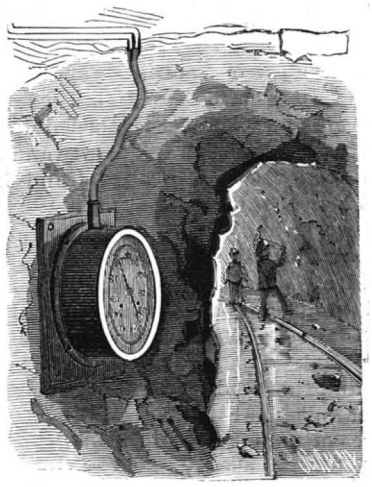


Fig. 9.—TELE-THERMOMETER—A MINE.

When a message or urgent dispatch was to be forwarded, the canine messenger could often be utilized. His speed and comparatively small size would render him a more difficult object to hit than the mounted soldier. The rapidity of conveyance of the dispatch would be important. A dog has run 2 kilometers, nearly 1¼ miles, in 2 minutes and 45 seconds, on an ordinary road. This exceeds any available means of transportation except a very good horse or steam. The ordinary trooper could not ride it at anything like that speed.

Among the other services that of ammunition carrier has been suggested. The trouble in this case would be that the load would be light. It is at least one additional service. A reference to the record of the St. Bernard dog suggests the utility of the animal in such service as that of the Red Cross Society. He could be made to scour the battlefield after an engagement, rendering assistance in the discovery of the wounded and directing the relief parties to those needing their service. Many wounded soldiers lying on the outskirts of the field in isolated places might thus be found.

The subject has long attracted the attention of military men. The French and Germans have, it is said, many dogs in training. On the Belgian frontiers the smugglers have used them for years to transport dutiable goods, and the custom house officers have their own corps of dogs to counteract the smugglers' operations. They have, however, not yet been fully enlisted in the military service. It is not impossible that they may yet play an important part in war operations. The bicycle adds to the speed of a soldier where the ground is such that it can be employed. But the dog is to a great extent independent of the nature of the ground, and can make rapid progress over fields and through forests where horse or bicycle would be seriously delayed.

New Labor Laws in New York.

A new law provides that the salary of laborers employed by the State or any officers of the State shall not be less than $2 a day or 25 cents an hour. In all cases where laborers are employed on any public work in this State, preference shall be given to citizens of New York State. Several other so-called labor bills of importance became laws. One provides that every union or association of working men or women adopting a label, mark, name, brand, or device intended to designate the products of the labor of members of such union or association shall, in order to obtain the benefits of the act, file duplicate copies of such label, name, mark, brand, or device in the office of the Secretary of State, who shall under his hand and seal deliver to the party filing or registering the same a certified copy and a certificate of the filing thereof, for which he shall receive a fee of $1. Another amends the revised statutes so as to extend the exemption of household furniture and working tools over districts from warrant and sale under execution. A third law exacts that all corporations shall pay the salaries due their employes each week up to within six days of the date of payment, and also that it shall not be lawful to pay their employes in their own scrip, commonly known as "store orders." The penalty for such offense shall be not more than $50 nor less than $10. The complaint must be made within thirty days.

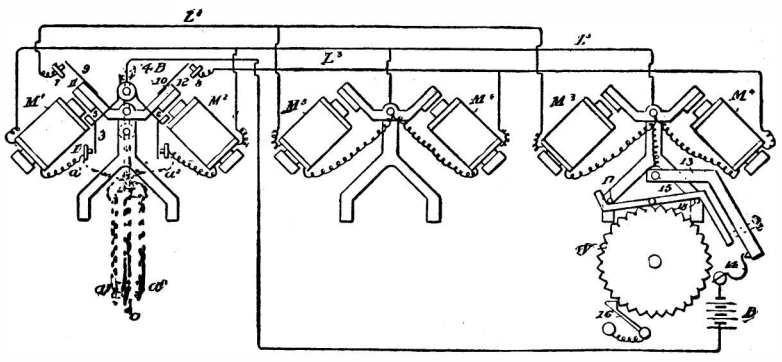


Fig. 5.—DIAGRAM OF CIRCUITS.

Liquefied Carbonic Acid Gas.

M. Gall has recently devised another method of preparing carbonic acid gas, which, in its liquefied and solid states, is now pretty largely used. The gas is obtained by burning coke, about 18 per cent of the products of combustion being this gas. Any sulphuric acid is eliminated by washing, and the whole is then passed through a solution of carbonate of sodium or potassium. The nitrogen and any oxygen there may be in the gases pass through the solution unchanged and are allowed to escape into the air. The carbonic acid, however, is retained in the solution, changing the mono into a bicarbonate. This solution is afterward transferred to a boiler, where the bicarbonate is again reduced to the monocarbonate, the gas driven off is collected in a suitable receiver connected with the suction pipe of the compressing pump, while the sodium carbonate is used over again to fix another supply of the gas. The compression of the gas is carried out in three cylinders, in the first of which it is raised to a pressure of 73·5 lb. per square inch, in the second to 367 lb., and in the third to 883 lb. per square inch, under which pressure it liquefies.

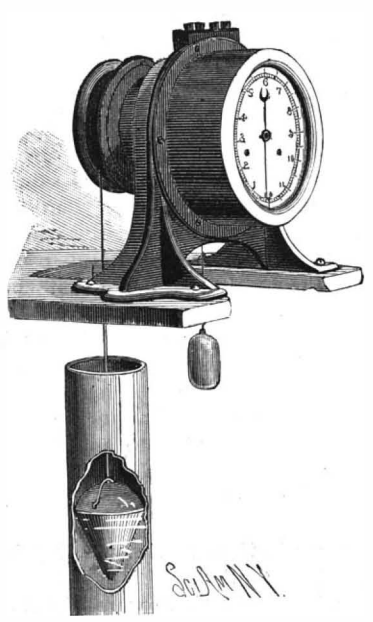


Fig. 10.—TELE-HYDROBAROMETER.

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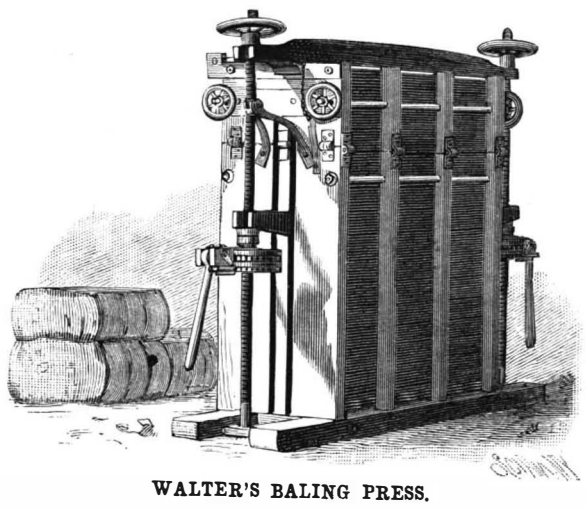
AN IMPROVED BALING PRESS.

A portable hand baling press, designed for use in the baling of cotton, wool, broom corn, hay, etc., is illustrated herewith, and has been patented by Mr. Willard E. Walter, of Silver City, Idaho Ter. It is a box-like structure mounted on a bed frame of sills united by heavy bolts, the side and end walls also being connected by bolts. To each of the side and end walls are also hinged doors. The end walls are slotted to provide for the passage of a double truss upon which is mounted a follower, and between the ends of the sections of the truss are threaded shafts carrying double ratchet nuts that bear against wear sleeves extending upward between the sections. The lower ends of these threaded shafts are held by the bed plates, while brackets support their upper ends, to each of which is hinged a threaded rod passing up between the end sections of an upper double truss connected to the press head, the ends of the rods having hand wheels and binding nuts.

The double ratchets on each end of the press are provided with lever heads pivotally connected with lever arms. To fill the baling chamber, the side doors and press head are thrown open, and the ratchet nuts at the ends turned down, when the follower may be lowered nearly to the bottom of the structure. When the press is filled with the material to be compressed, the press head, threaded rods, and side doors are moved to the position shown in the engraving, the lever heads

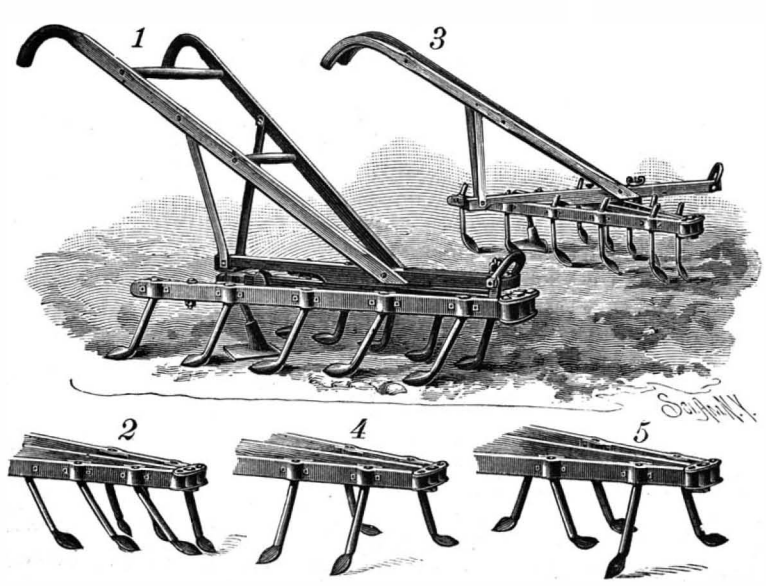


WALTER'S BALING PRESS.

being applied to the ratchet nuts and the end levers operated to force the follower upward till the material is sufficiently compressed, when the binding wires or cords are fastened in place.

AN IMPROVED CULTIVATOR.

The accompanying illustration represents a combined cultivator and harrow, for the general preparation of land before planting, and for use afterward in the general cultivation of all kinds of crops. It has been patented by Mr. James Shoolbred, of Eastover, S. C. Fig. 1 shows the implement as a smoothing harrow, presenting an angle tooth at an angle of 45°, with flanged feet, to ride roots, rocks, etc., and cut through sod without dragging. Two or more can be connected to a pole and used as a smoothing harrow, and then as separate cultivators, the center tooth being adapted to any attachment. In Fig. 3 the harrow is shown as a scarifier, with teeth at right angles and flanges at 45°, for cutting through old sods or for deep tillage, the pivoted draught beam being thrown to one side to show its capacity. Fig. 2 shows the implement as a grass rake or wire grass extractor, the teeth being thrown forward, while Fig. 4 shows it as a cultivator, which, by removing the center tooth, cultivates both sides of a row at once. In Fig. 5 the harrow is represented as a cultivator for an entire alley, adaptable to any width of row, the pivoting of the draught beam allowing it to be thrown at any angle or position to the line of draught, whereby the frame may be drawn along longitudinally to the line of the draught beam, or at right angles thereto, or at any intermediate angle, for the purpose of securing a different action of the teeth. The frame for supporting the teeth is composed of a central beam and pivoted wings, the teeth having cutting lower portions and angular shanks, whereby the teeth may be adjusted to change their action upon the land. The teeth are changeable to eight separate distinct positions, affording opportunity for an indefinite number of combinations.



SHOOLBRED'S CULTIVATOR.

AN IMPROVED SEED PLANTER AND FERTILIZER DISTRIBUTER.

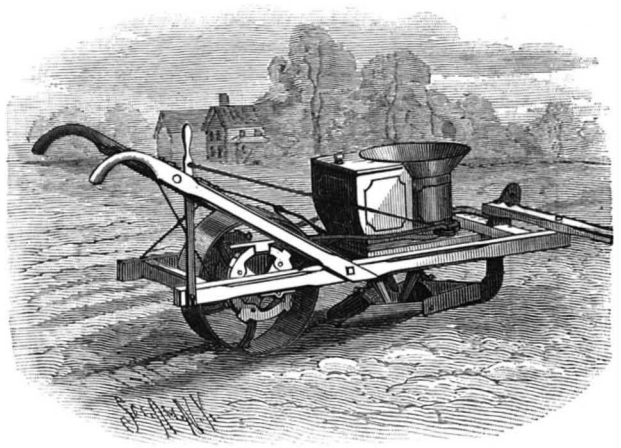
A planter designed to drop the seed and fertilizer in holes any desired distance apart, adapted to drop two different kinds of seeds if desired, and in which the dropping device may be operated either automatically or by hand, is represented in the accompanying illustration, and forms the subject of two patents issued to Mr. Whitmon A. Holt, of Harrison, Me. A plow is held in the front end of the frame of the device, the driving wheel being in the rear, while a fertilizer hopper is held to turn on the frame by the rotation of the driving wheel, and a seed box is held stationary on the frame at the rear of the fertilizer hopper. A drop plate is held on the fertilizer hopper and operates under the seed box, a seat with apertures being secured on the main frame under the drop plate and fertilizer hopper, fixed arms held in the fertilizer hopper covering up alternately the discharge openings in the bottom of the hopper. Combined with the hopper is the seed box, secured on the apertured fixed seat, the drop plate held on the hopper projecting under the slotted bottom of the seed box, which is divided by a partition into two compartments, and rods connecting it with the hopper, cam wheels operating the rods, and these cam wheels being actuated by the main driving wheel. A rod connected with one side of the hopper is pivotally connected with a lever for turning the hopper by hand. On the main plow is pivoted a mould board, and covering shovels are pivotally connected with the mould board at its end, with means for connecting the rear ends of the shovels with each other.

The Society for the Preservation of Ancient Egyptian Monuments.

Egyptian archæology has unquestionably placed a plentiful supply of materials at the service of modern painters and writers of historical romances, enabling them to impart a charm of realism into their respective presentations of the life, arts, and customs of the Egyptians from the misty ages of Mena to the gorgeous periods of Cleopatra or to the times of Diocletian's implacable persecutions. Still, it cannot be said that the science of Egyptian archæology is complete and to be developed no further. Unworked veins of information exist in the remains of palaces, tombs, and temples erected in past times by a Thotmes, a Rameses, or a Ptolemy along the banks of the Nile. For the purposes of completing natural history, vestiges of extinct evolutions or creations are eagerly rescued and carefully preserved for successive investigators. The performance of a similar duty is surely due to Egyptian archæology. The sense, however, of such an obligation has not acquired strength enough to provide the necessary protection *in situ* of the monumental relics of ancient Egypt, and the consequence is that their gradual destruction has been reduced to a system through the combined operations of natural causes and of depredatory Arabs, tourists, and curiosity mongers.

To endeavor to arrest the progress of such irreparable mischief the above named society has been recently formed. Sir Henry Layard, Mr. Flinders Petrie, Lord Wemyss, Sir William Gregory, Sir Frederick Leighton, Mr. Le Page Renouf, Lord Wharncliffe, Lord Carlisle, Sir Colin Scott-Moncrieff, and General Brackenbury are leading members of its executive committee. Mr. E. J. Poynter, R.A., is honorable secretary, and Mr. Bertram Currie is honorable treasurer.

Both Lord Salisbury and the Egyptian government have warmly testified their appreciation of the intentions of the society. The Egyptian government, indeed, have taken the important step of causing a careful survey to be made of those ruined temples and palaces which suffer more severely than others from perennial infiltrations of the Nile and from the destructiveness of human agencies. A full report has been drawn up by a French engineer, Grand Bey, and the estimated cost of propping masonry in imminent danger of falling, of draining and clearing various sites, and of fencing round groups of ruins, from Philæ to Abydos, is £8,500. The society proposes to raise this sum by public subscriptions, and to place it with the least possible delay at the disposal of the Egyptian government, who will thus be enabled to at once rescue the remains of some twenty most important monuments, such as the temples at Esneh, Luxor, and Karnak. The Egyptian government has given a further earnest of its desire to

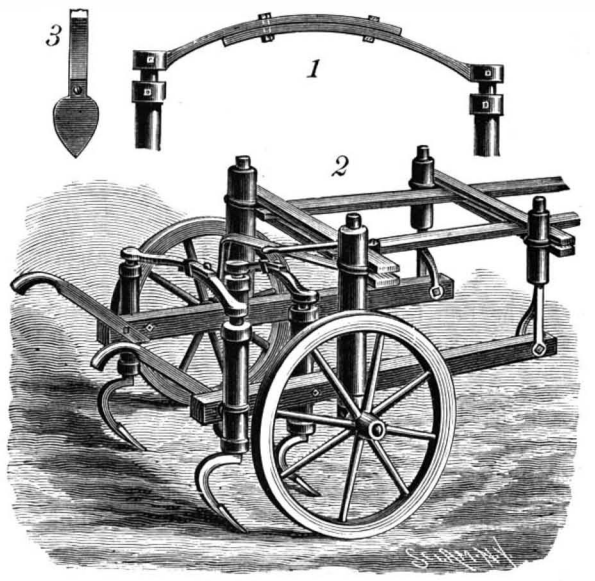


HOLT'S SEED PLANTER AND FERTILIZER DISTRIBUTER.

do its utmost in the matter by undertaking to provide proper inspection and guardianship of the ruins in future.

AN IMPROVED CULTIVATOR.

The accompanying illustration represents a construction styled by the inventor the "Texas Perfection Cultivator," which is designed to be adjusted laterally to any width and vertically to any desired height. It is a patented invention of Mr. John C. Benthall, of Schulenburg, Texas. The front cross bar consists of two spaced beams, near each end of which are metal boxes having each a vertical groove in which a tube is perpendicularly held by an eyebolt provided with a lock nut, so that the position of the tubes with respect to the length of the beams may be readily changed as desired by sliding the blocks toward or away from the center. Supported at their forward ends by rods carried upward through these tubes are two spaced longitudinal beams, these beams carrying, at the rear of the axle, on their inner and outer faces, vertically adjustable tubes, through each of which is passed the rod or standard of a share carrier, the lower end of which is curved, the blades being such as are



BENTHALL'S CULTIVATOR.

usually employed in cultivators, as shown in Fig. 3. The top of each standard is provided with an arched or curved iron by which the two opposing standards are adjustably connected, as shown in Fig. 1, one iron overlapping the other to form an arch, and each iron having a registering slot and bolts by which the two members are clamped together. The axle is arched, and consists of two transverse beams, on the rear face of which are adjustable boxes, each carrying a vertical tube in which the vertical member of an angled spindle is inserted, upon the horizontal member of which the drive wheels are loosely mounted. By this construction the distance apart of the drive wheels may be readily arranged to accommodate the adjustments of the machine, and in working crops of considerable height the axle arch may be conveniently raised as desired. When the machine is used as a walking cultivator, it is guided by carrying the handles either to the right or left; and when employed as a riding cultivator, a lever is employed which is fulcrumed upon the axle arch near one end and connected by a link and rod with the opposite longitudinal beam.

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THE PARIS EXHIBITION.

THE LOCOMOTIVE EXHIBITS—THE ITALIAN SECTION.

PARIS, July 4.

There are three Italian locomotives here, all differing in their details of construction, while each detail has its counterpart in some one or other of the French or Belgian exhibits, and is, in the main, distinct from American or English practice. Beginning with one over which hangs the signboard *Strade Ferruta Meridionali Bele Adriatica Italia*, it is a four-wheel coupled engine, has outside cylinders, say 20"×26", and a single guide bar, which is the only feature about it copied from American practice.

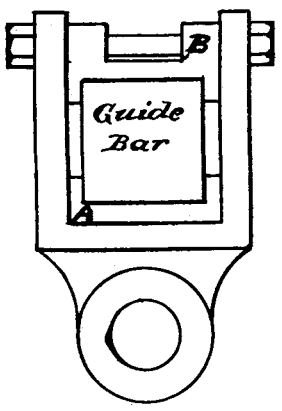


Fig. 1.—CROSSHEAD OF AN ITALIAN LOCOMOTIVE.

The construction of the crosshead is shown in Fig. 1, in which the pieces represented by A and B are of brass, while the rest is of wrought iron. A feature on this engine that requires attention (because I find it on several other engines, both English, French, and Belgian) is that the end of the piston rod is enlarged to form the cone that goes into the crosshead. This necessitates that there be a bush or sleeve fitting into the gland and being put in in two halves, a construction for which I see no necessity. The only object there can be is to strengthen the rod cross section through the keyway; but piston rods do not break there if of good material and if the taper of the rod end is correct, because, if there is not too much taper and the cones are well fitted, the friction of the surfaces will almost hold them together; but if there is too much taper on the cones, the friction is diminished, more strain falls on the key and the metal on the sides of the keyway, and breakage is likely to follow. The connecting rod end of the engine is shown in Fig. 2, in which the usual order of things is reversed,

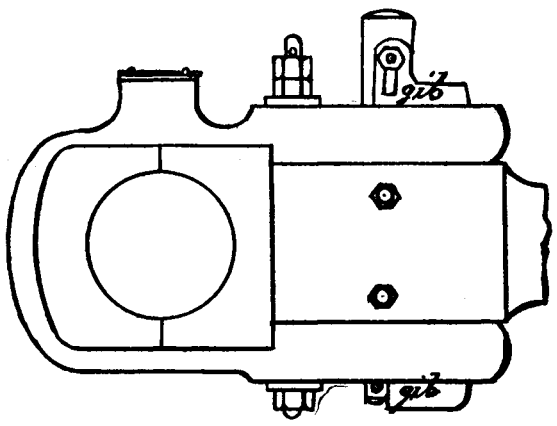


Fig. 2.—CONNECTING-ROD END—ITALIAN LOCOMOTIVE.

since the bolt is put between the key and the brasses, necessitating that the bolt be slackened back each time the key is used, to adjust the brasses.

Again, in order to let the strap pass up the rod as the key is driven in, the bolt hole must be slotted either in the connecting steel end or in the strap. Hence the holding power of the bolt is confined to that of the nut, there being no grip of the circumferential surface of the bolt, as there is with a taper bolt filling and driven into its hole. We may now consider the key and gib arrangement, and it will be perceived that the gib extends upward to provide a slot to receive a pin projecting from the key, the nut on this bolt locking the key to the gib, which is a very expensive form of construction. In addition to this, however, there are the two set screws also holding the key and a pin at the bottom, so that, taken as a whole, we have a complicated as well as an unhandy design, without any compensating advantages. The oil cup of this rod requires also attention, since it represents a construction found on many engines here. The interior construction is, I am informed, simply a siphon, such as shown in my previous article on the locomotives here. Side and plan views are given in Fig. 3, in which *a*, *b*, *c*, *d* are four pins or studs, through which pass the long split pins, *e*, *f*, which hold down the cap or cover, *g*. At *h* is a circular projection forming a dish, *r r*, in the center of which is a button or disk held up by a spring, so that to put oil in the cup this button must be depressed. The object is, of course, so far as the button is concerned, to exclude the dust; but the whole design is very expensive and with no compensating advantages.

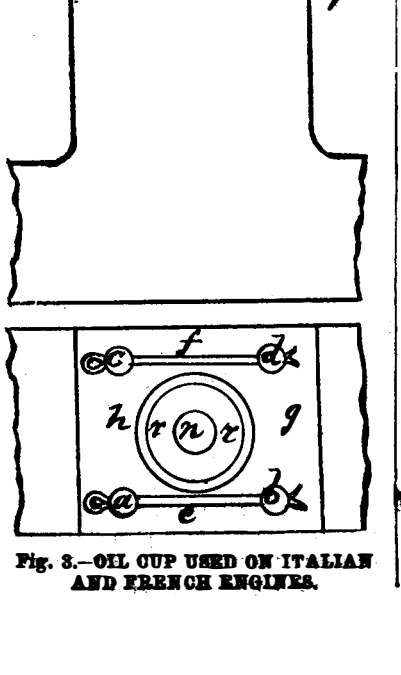
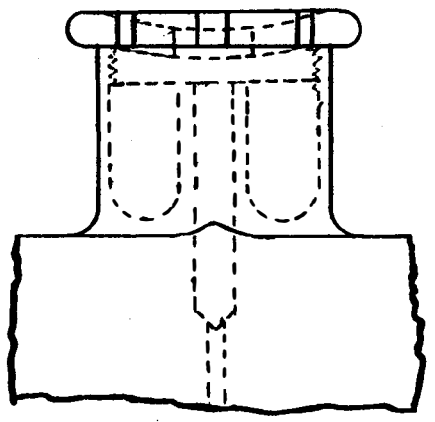


Fig. 3.—OIL CUP USED ON ITALIAN AND FRENCH ENGINES.

The old form of oil cup, when forged solid on the rod,



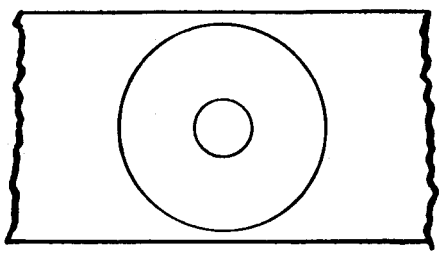


Fig. 4.—SOLID OIL CUPS.

is as in Fig. 4, the objection to it being that it required turning inside and out, and to save some of this work English builders let the outside be square instead of round, which was easily done with the rest of the strap when on the planing and slotting machine, and involved no extra chuckings. The English, however, use a round cap that screws into the square cup, and in place of the threads the Italians and French put on a square cap with four pins and two split pins, which is more expensive and no better, since a cork or plug screwed into the oil hole of the round cap is just as good as the spring button of the square cup. There are no locomotives here with the American form of sight lubricators, nor with oil cups that screw in or are fastened on to the straps, except the solid grease feeder shown in my last letter.

Another form of rod end is shown in Fig. 5, the prominent features being that the back brass, *b*, can, when the key is out, be moved back far enough to let the crank pin, *c*, pass through the slot in the rod, and thus facilitating the putting on and taking off of the rod. The method of securing the key is by means of a plate, *p*, provided with a slot, through which passes a bolt which screws into the key. This is a more expensive construction than two set screws without the plate would be, while it is certainly no better.

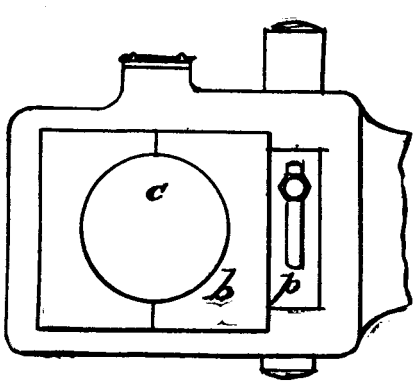


Fig. 5.—COUPLING ROD END—ITALIAN LOCOMOTIVE.

Coming now to the eccentric rods, they are of wrought iron, with one-half of the strap forged solid on the rod, the strap being brass-lined.

The boiler has one water gauge glass and three gauge cocks, all three being within the same range as the glass of the water gauge. The dome top is provided with a spring balance, but a pop valve is provided separately. The boiler feed is by injectors situated under the foot plate. The engine brakes are operated from a hand screw, and act on one side of each wheel, only the force being applied to force the two wheels on one side of the engine apart.

The *Giovanni Darco*, No. 1,701, is an Italian engine designed this year, is a bogie engine with four wheels coupled, and has outside cylinders, ordinary crosshead and guide bars. Her connecting rod is a combination of several styles, as will be seen on reference to Fig. 6.

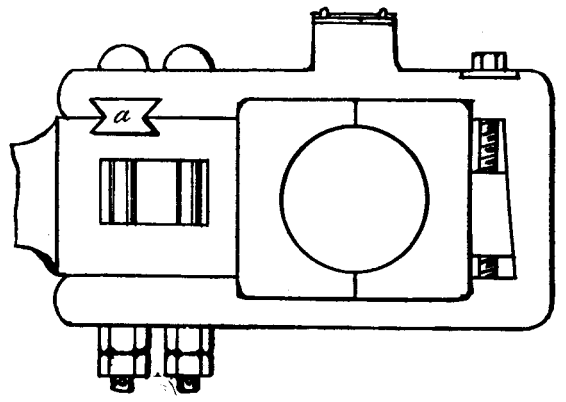


Fig. 6.—CONNECTING ROD ON AN ITALIAN LOCOMOTIVE.

The strap is held to the stub end by two bolts, as in ordinary English and some American practice; but a die, *a*, is introduced, which is a decided detriment, for a long experience of such dies taught me that they are very expensive to fit, very difficult to make a good job of, and get loose as soon as much duty is thrown upon them. They were first used on the Sharp-Roberts engines, but were soon discarded. The employment of a cap and collar for the wedge screw is also faulty, because it weakens the strap and does not look mechanical. The rod is of similar design at the driving end. The valve gear has Crampton eccentrics (that is, eccentrics driven from a return crank arm) and Gouch links, the slide spindle being provided with a crosshead sliding in a guideway, the steam chest being at an angle of abont 40°. This engine has a hand screw brake gear, the brakes being released by weights.

Another engine, whose sign reads "Officina Meccanica Miani Silvestri, 1889, Milano," has a bogie or truck, outside cylinders, and is six-wheel coupled. The most notable thing about her is her coupling rod, a section of which is shown in Fig. 7. I have not as yet been able to find an attendant at this engine, or I should have endeavored to discover the object of the second bolt (that at *a*) to the double eye. I presume, however, that it is to save wear at the joint, *b*, the tongue in the middle of joint, *b*, passing beyond *a*, and having a slotted hole to receive the bolt of *a*. To whatever extent the joint is made more rigid by this construction the body of the rod will have to bend in going round a curve. Hence there is no gain.

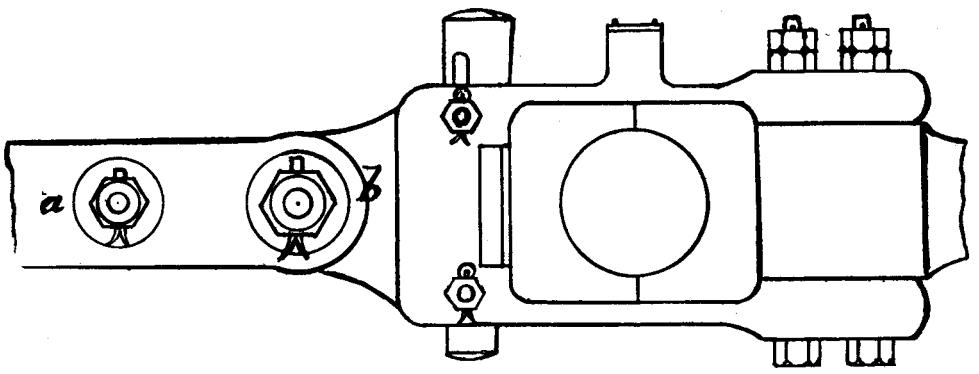


Fig. 7.—COUPLING ROD OF AN ITALIAN LOCOMOTIVE.

The method of securing the key is a decidedly expensive one, besides involving a good deal of trouble in getting the key in or out. The bolts, be it observed, pass through a slot in the key. It may also be pointed out that the keys are not given as much taper as in either English or American practice. I have not deemed the dimensions of the engine, or the construction of their boilers, etc., of sufficient importance to warrant my giving these details; indeed, I look upon them, the French, and the Belgian locomotives, as in a state of transition, not only so far as their general designs are concerned, but also with regard to the details.

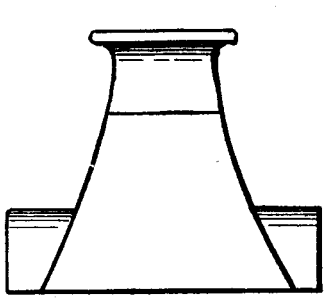


Fig. 8.—A SQUARE SMOKESTACK ON A BELGIAN LOCOMOTIVE.

On some of the Belgian engines here the smokestack is square, as in Fig. 8. Anything more unmechanical, as well as homely, it seems hard at first sight to imagine; indeed, one

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hardly knows whether to laugh or to get mad at it, but as the days wear on, one gets used to it, although not reconciled to it. JOSHUA ROSE.

[SPECIAL CORRESPONDENCE OF THE SCIENTIFIC AMERICAN.]

The Paris Exhibition.

THE UNITED STATES SECTION—GENERAL.

PARIS, July 20, 1889.

There are two exhibits in the American department or section that go far toward redeeming its general dullness. One of these is the exhibit of the engraving and printing department at Washington, D. C., around which linger authors, editors, publishers, engravers, printers, etc., and a fair share of the general public; and the other that of the Drake Co., St. Paul, Minn., whose exhibit consists of agatized woods from Chalcedony Park, Arizona. This latter exhibit stands out boldly in a glory and richness that draws the multitude at once, and makes it somewhat difficult to inspect it as one would like. The samples consist of sections of trees, ranging from 2 feet 6 inches in diameter, and say 2 feet high, down to pieces not more than 3 inches in diameter. Next come table tops of various diameters and disks suitable for ornamental work and clock faces, tiles suitable for interior decoration, door knobs, paper weights, etc. Of course it is the larger specimens that excite the most admiration, some table tops fetching from $300 to $400. I hear of its being employed for the decoration of mansions, especially for mantels, tiles for fireplaces, panels for over mantels, and other similar applications, where great durability combined with elegance is a requisite.

The geological interest in the exhibit arises from the fact that it is from the largest deposit (if it may be so called) of silicified wood in the world, containing, it is said, a million tons, covering a thousand acres, one of the fallen tree trunks being visible for a hundred feet in length, and forty-five feet of it forming a natural bridge. The geological interest in some of the samples lies in their having the bark on intact and perfect (which has hitherto been unknown) and in the remarkable brilliancy and beauty of the colorings, which is probably due to the exquisite polish they take. The colorings embrace every imaginable shade of the yellows, black, reds, grays, browns, white, and greens, combined in all sorts and manners of ways, not splashy as in marble, but sometimes blended, at others mottled or spotted, as it were; while in yet others they seem to radiate in circular waves from the center, almost like waved rays of colored sunlight. The specimens are solid to the core and without blemish. Some of them are small columns turned and polished; but the greatest beauty is shown in the across-grain surfaces. The black specimens, I think, are what are called by the West Indian aborigines *tacuba* posts, that is to say, in many of the hard woods the outside of the trunk is a light color, while the core (which is not usually more than about 8 or 10 inches in diameter) is dark, and in some cases a smoky black, just as the dark specimens here are.

Mr. F. C. Hatch, who is in charge of the exhibit, says they never find any bark on these dark specimens, and this lends probability to the supposition that they are tacubas or cores. There is one specimen attracting particular attention on account of its unusual degree of transparency in places, and in one of these places there is a coloring reminding one of the bloom on a well grown Hamburg grape or a luscious plum. A Russian dealer gave recently $500 for a piece 28 inches in diameter and 30 inches long, to be cut into table-tops. Limb specimens are sold very freely at as low as $2, the English especially being purchasers. The material is strong, of course, and exceedingly hard to cut and polish, and hence the expensiveness. To cut through a 2 foot log takes thirty days, and wears the saw down from 6 inches to 2 inches wide. Corundum and emery used in connection with a chemical are applied to the saws. The polishing is done on a large iron disk revolving horizontally and supplied with emery and a chemical. Small pieces are polished embedded in plaster of Paris. Some of the small specimens are cameo cut, and these are finding great favor as reminiscences of the exhibition.

The exhibit of the Bureau of Engraving and Printing naturally contains a great many examples of bank note work, and also engravings representing the heads of all the presidents, generals, admirals, and prominent officials and public men of the United States. The beauty of some of the engravings cannot be seen without the aid of a magnifying glass. It seems a pity that one of the engraving machines is not exhibited, but there are only three or four of them in existence, I believe, and all of them are kept in locked rooms and very zealously guarded all day and night. I am enabled, however, to give an idea of their construction and some interesting facts concerning them. The depth of the lines of the border work say of a greenback is the one three-thousandth part of an inch deep, and the tool goes over the line thousands of times before it is cut to that depth. The tool-cutting edge is formed by grinding three flat facets at an angle of 45° to the center line of the tool, the cutting point thus formed being at the extreme end or point of the tool.

The engraved plates for printing bank notes are inked with the palm of the hand (for which there has not as yet been found any substitute), and if the plates are left soft, about sixteen thousand inkings wear out the plate. Of course it would be out of the question to harden these plates in the usual way, as the warping alone would destroy them, but it is a fact that a process of casehardening them "cold" has been discovered and practiced by a skillful mechanic in New York city named Whitely. I am not prepared to say that the term cold is strictly correct, although that is what is generally stated. I am of opinion, however, that a temperature of say about boiling point is employed. The process is of course a dead secret and is on doubt purely chemical. The specimens I examined were fairly well casehardened and had not been heated enough to change their color in the least. The casehardened plates will print about 50,000 or 60,000 impressions. The motions of a bank note printing machine may be very roughly described as follows: A sliding table having rectilinear motion carries a compounding table having similar motion, but in a line at a right angle to that of the first. The length of stroke and the speeds of these two tables may be varied at will, so that either of them may be made to have equal or unequal stroke in a given time, the range of combinations running into the thousands. The upper table carries the work-holding chuck which may be an elliptical or any other kind of chuck suitable for the class of work in hand. The tool is mounted in a rest on a slide that spans the tables.

The number of change wheels for setting the combinations for the table motions are bewilderingly numerous, and it requires a wonderful amount of skill to work the machine. It took the English a good many years to perceive or at least to acknowledge the superiority of the work of this engraving machine, but about six years ago an English firm bought from the maker in Newark, N. J., a machine for $8,000, but the maker refused to deliver the machine until a man had been sent out to learn to work it, which after much discussion was done; but the man, who was an expert upon English machines, didn't want to be taught, but to be left alone with the machine, so as to show how foolish it had been to bring him to the United States to learn how to use an engraving machine. So he was left alone with the machine for three weeks, after which time he gave it up and meekly requested to be taught. The work on these engraving machines must be of the very highest order, better than for any other machine that is made of metal. A rather curious fact with reference to this section of the exhibition is that while every State in the Union has appointed and has a commissioner here, only one State (Florida) has a State exhibit, the other commissioners having nothing whatever to do.

The Florida exhibit consists of cotton, tobacco, resin, wood, and sponges, with some photos and a few other unimportant items, occupying in all a small space of about 60 feet by 14 feet high. One thing that detracts from the United States general section is that it does not compare at all well in the matter of the general decoration or ornamentation, upon which a good deal has been spent in the general sections of other countries.

The brass work exhibited by the Robertson Lamp Co., of New York, contains some excellent exhibits, and there is no doubt that brass work for the household is one of those things that is bound to increase very much in the United States. Brass bedsteads are beautiful and elegant, and just the class of work on which Americans can bring self-acting machinery to bear so as to avoid expensive labor.

The Rookwood exhibit of art pottery, small as it is in comparison to that in some of the foreign sections, is quite up in quality to any of them. In one point the American sections surpass all others, and that is the visitor has no trouble in finding out anything he wants to know. One only has to show an interest and the attendants are alert, in a moment giving every detail of information, pointing out this, explaining that, and referring to the catalogues, which are far better got up than those of any other nation. JOSHUA ROSE.

Dentistry in 1796.

American dentists of the present day may, with justice, lay claim to a high reputation for skill and ingenuity. The autograph letter of Washington, which appeared in the *Journal* of June 17, showed that considerable enterprise was shown also by our dental forefathers. We have before us an interesting document which gives quite accurately the degree of proficiency which had been reached in dentistry toward the close of the last century. It consists of an advertisement issued by one Josiah Flagg, surgeon-dentist, who "informs the public that he practices in all the branches with improvements, *i. e.*, transplants both live and dead teeth with great conveniency, and gives less pain than that heretofore practiced in Europe or America; sews up hare-lips; cures ulcers; extracts teeth and stumps or roots with ease; reinstates teeth and gums that are much depreciated by nature, carelessness, acids, or corroding medicine; fastens those teeth that are loose, unless wasted at the roots; regulates teeth from their first cutting to prevent fevers and pain in children; assists nature in the extension of the jaws for the beautiful arrangement of the second set, and preserves them in their natural whiteness, entirely free from all scorbutic complaints. And when thus put in order, and his directions followed (which are simple), he engages that the further care of a *dentist* will be wholly unnecessary; eases pain in teeth without drawing; stops bleeding in the gums, jaws, or arteries; lines and plumbs teeth with virgin gold, foil, or leads. Fixes *gold roofs and palates*, and artificial teeth of any quality, without injury to, and independent of, the natural ones; greatly assisting the pronunciation and the swallow, when injured by natural or other defects. A room for the practice, with every accommodation at his house, where may be had dentifrices, tinctures, teeth and gum brushes, mastics, etc., warranted approved and adapted to the various ages and circumstances; also chew-sticks, particularly useful in cleansing the fore teeth, and preserving a natural and beautiful whiteness; which medicine and chew-sticks are to be sold wholesale and retail, that they may be more extensively useful.

"Dr. Flagg has a method to furnish those ladies and gentlemen, or children, with artificial teeth, gold gums, roofs, or palates, that are at a distance and cannot attend him personally.

"Cash given for handsome and healthy live teeth, at No. 47 Newburg Street, Boston (1796)."

The document is ornamented in one corner by very formidable and antiquated instruments, while in the other are to be seen tooth brushes quite of the modern pattern. It has been preserved by a descendant of one who, as may be seen on the back, purchased a brush and tincture from Josiah Flagg in the year 1800. —*Boston Medical Journal*, 1875.

Sense of Smell in the Horse.

The horse will leave musty hay untouched in his bin, no matter however hungry. He will not drink of water objectionable to his questioning sniffs or from a bucket which some other odor makes offensive, however thirsty. His intelligent nostril will widen, quiver, and query over the daintiest bit offered by the fairest of hands. A mare is never satisfied by either sight or whinny that her colt is really her own until she has certified the fact by means of her nose. Blind horses, as a rule, will gallop wildly about a pasture without striking the surrounding fence. The sense of smell informs them of its proximity.

Others will, when loosened from the stable, go directly to the gate or bars opening to their accustomed feeding grounds; and when desiring to return, after hours of careless wandering, will distinguish the one outlet and patiently await its opening. The odor of that particular part of the fence is their guide to it. The horse in browsing, or while gathering herbage with his lip, is guided in its choice of proper food entirely by its nostrils. Blind horses do not make mistakes in their diet. In the temple of Olympus a bronze horse was exhibited, at the sight of which six real horses experienced the most violent emotions. Ælian judiciously observes that the most perfect art could not imitate nature sufficiently well to produce so perfect an illusion. Like Pliny and Pausanias, he consequently affirms that "in casting the statue a magician had thrown hippomanes upon it," which, by the odor of the plant, deceived the horses, and therein we have the secret of the miracle. The scent alone of a buffalo robe will cause many horses to evince lively terror, and the floating scent of a railroad train will frighten some long after the locomotive is out of sight and hearing.—*Horse and Stable.*

THERE was an interesting exhibition recently at the naval proving ground at Annapolis of the Maxim automatic machine gun, under the direction of Mr. Hudson Maxim, a brother of the inventor. The *Army and Navy Register* says: Three guns were used, two rifle caliber guns and a 1-pounder, caliber 37 millimeters. These guns were built in England, and are much more perfect than those which were exhibited to our war and navy departments a year and a half ago, and at that time awakened so much interest. The rifle caliber guns yield 700 to 750 shots per minute respectively. The 1-pounder yields nearly 400 shots per minute. Over 100,000 rounds of ammunition had been purchased for this trial, and a large party was present, including Commodore Sicard, chief of ordnance. Two 6-pounder Maxim guns, built on the same principle as the smaller guns, are expected here soon, and will be tried on the same grounds. One semi-automatic gun fires 60 shots per minute and the other, which is fully automatic, will give 150 shots per minute. It is probable that a company will soon be established in this country for the manufacture of the Maxim guns.

The best builders keep on file the Architects and Builders Edition of the "Scientific American." It enables a person about to build to select from the engravings the style of house suiting his fancy and purse.

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The San Diego Flume.

This work is described in the *Golden Era*, San Diego, Cal.

The head of the system is in the Cuyamaca mountains, nearly 5,000 ft. above the sea. Here a reservoir is formed by a dam 35 ft. high and 720 ft. long, impounding about 3,740 million galls. of water and covering 900 acres. From the reservoir the water passes down a rocky ravine about 12 miles to the San Diego river, and just below this point of juncture with the river is a dam of solid masonry diverting the stream into the flume through regulating gates. This dam is 400 ft. long and 35 ft. high, and cost $36,000. Behind this dam is another lake of considerable dimensions.

From the head gates to the reservoir, 8 miles from the city of San Diego and 630 ft. above the city, is a distance of 35¾ miles. This is the length of the flume proper. This flume is 6 ft. wide and 4 ft. high and is built of clear redwood plank 2 in. thick. At present but one tier of side planks is used, making the height 16 in. The full capacity of this flume is 5,000 miner's in. daily, or 65,000,000 galls., a quantity sufficient to irrigate 100,000 acres. The trestle work on this flume line is very substantially built, and the Los Coches trestle, one of the largest, is 65 ft. high in the deepest part of the valley and 1,774 ft. long; the Sweetwater trestle is 81 ft. high and 1,264 ft. long, and many others assume very considerable proportions. The total number of trestles is 315. The gradient throughout is 4 ft. 9 in. per mile. In addition to the trestles a number of tunnels had to be driven, 6 ft. square, or arched where the rock was bad. The longest tunnels are: Laukersheim, 1,900 ft.; Los Coches, 313 ft.; El Monte, 290 ft.; Cape Horn, 700 ft.; South Fork, 200 ft.; Anderton, 270 ft.; and Sand Creek, 430 ft. long.

Besides supplying the city of San Diego, through the distribution system of the Coronado Water Co., this water is to be utilized for irrigation purposes, the surplus supply being sufficient for 40,000 acres. The present watershed under control is set down at 150 sq. miles, and other storage reservoirs will be constructed as the need arises. One of these sites, near the La Mesa tract owned by the company, will impound 760,000,000 galls. of water, and the other has a capacity of 1,250,000,000 galls.

THE LIGHTNING FLASH.

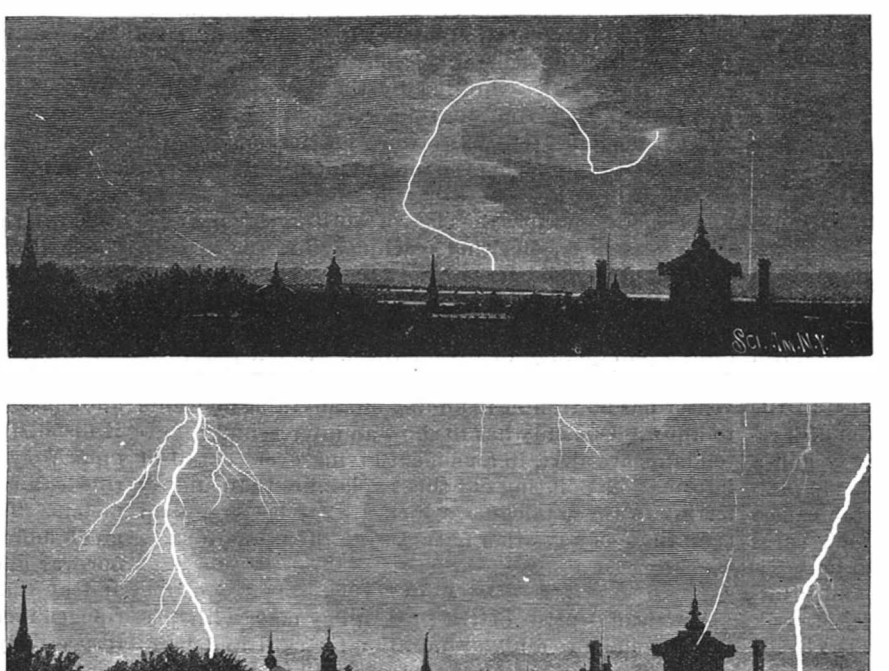
We illustrate in the accompanying cuts two very beautiful examples of photographs of lightning flashes. For many years a radical misconception obtained as to the shape of a flash. It was represented very generally by the artist as of zigzag shape. This is seen in old remains of art in the representation of the thunderbolts of Jupiter. Photography has done much to dissipate this erroneous view, but even without its aid the eye could, if prepared, see that the conventional shape was incorrect. Thus in watching the discharge of a powerful induction coil or of a Holtz machine, a certain sinuousity of outline can be recognized.

In the engravings the same form is to be seen. Nothing of the zigzag appears, and there is a total absence of anything approaching regularity. One cut shows a discharge which is exceedingly curved, its curious path being traced out in relief against the dark sky, the reasons for its course being quite unknown. Prof. Lodge's characterizations of the eccentric nature and ways of the flash seem quite warranted. In the other cut two flashes are shown, which exhibit the branching effect now often caught upon the sensitive plate.

The recent investigations by Profs. Herty and Lodge have done much to confuse as well as enlighten the mind upon this subject. The discharge of the Leyden jar can no longer be treated as a simple action. On the contrary, it is complex and consists of a series of oscillations, first in one direction and then in the other, lasting but an extremely short time, but in a small fraction of a second beating back and forth many hundred times. Prof. Lodge, addressing himself to the practical view of the subject, studied lightning rods and came to several rather startling conclusions. He decided that iron was a better material than copper, and that slight imperfections or even breaks in its continuity did little harm.

So radical a departure from the views hitherto held by scientists was not allowed to pass unchallenged, and Mr. Preece and others have opposed them strenuously. At the recent meeting of the Society of Electrical Engineers held in this city, Prof. H. A. Rowland, of Johns Hopkins University, spoke against them. He expressed his doubt as to whether the discharge of a thunder cloud was, as a rule, oscillatory at all, and thought that no comparison could properly be drawn between the natural and the Leyden jar phenomena. In regard to protection for a house, he expressed his opinion that a series of conductors crowning the roof in various directions and connected to copper wire conductors running to the ground would be efficient. Copper wire one-fourth inch in diameter, he stated, would be the proper material.

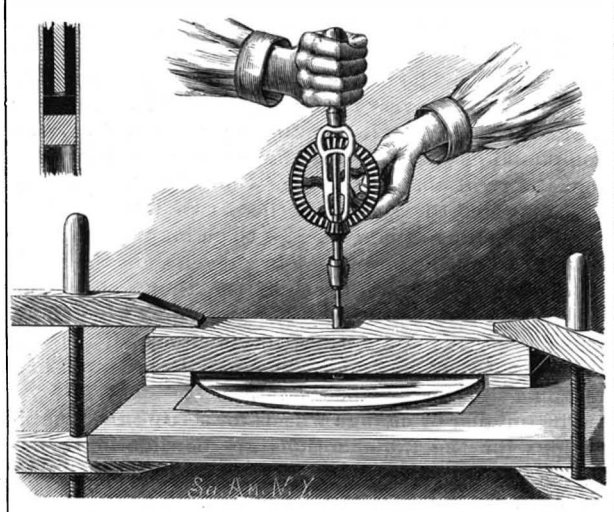
We are indebted for the original photographs from which our engravings were made to Mr. G. E. Davis, who is an amateur photographer, residing at Dubuque, Ia. Much of the effect of the photos is lost in the cuts.



PHOTOGRAPHS OF LIGHTNING.

HOW TO PERFORATE GLASS.

To make a small hole in a plate of glass is a comparatively simple matter. All that is required to do it is a very hard, sharp drill, some means for turning it, and a lubricant, such as turpentine, for causing the drill to cut rapidly. A drill made in the usual form from steel wire and hardened by heating it until it is dark red and then plunging it in mercury, will be very hard, but not tough. Before the drill is heated it should be driven into a block of lead so that its point will just be inclosed by the lead, and after the drill has been hardened in the mercury its point should be inserted in the indentation in the lead, and the temper of the shank of the drill should be drawn over a lamp or gas flame to a blue. The lead prevents the drill point from becoming heated sufficiently to draw the temper, by conducting the heat away as fast as it arrives at the point. When the shank of the drill becomes blue to within a short distance of the lead, the drill, together with the lead, should be plunged into cool water.



PERFORATING GLASS.

The drill prepared in this way should be wet with turpentine while in use to cause it to "take hold." It is advisable to drill from opposite sides of the glass whenever this is possible. The hole may be enlarged by means of a sharp round file wet with turpentine. When larger holes are required these can not conveniently be made with a drill. A copper or brass tube charged with emery and water or emery and turpentine, and rotated in contact with the glass, will soon cut a hole a little larger than the tube.

Simple ways of guiding and revolving the tube are shown in the annexed engraving. The glass to be drilled, which may be the plate of an electrical machine for example, is placed upon a table with a few thicknesses of paper underneath its center. Two blocks are placed on the table at diametrically opposite edges of the disk, and a thick bar of wood, which is bored at the center to receive the copper or brass tube, is placed upon the blocks and clamped firmly to the table. The glass plate is arranged so that its axis concides with that of the hole in the bar. The plate is then clamped in place by gently inserting two wooden wedges between the wooden bar and the glass.

The tube by which the cutting is done is stopped by a wooden plug at the middle of its length, and in the upper part is inserted a soft rubber stopper which rests upon the wooden plug, also a piece of heavy rubber tubing which rests upon the stopper. In the rubber tube is inserted one end of a close-fitting metal shank, the other end of which is fitted to an ordinary drill stock. This arrangement provides for a certain amount of flexibility in the connection between the tube and the drill stock. The tube is revolved by the gearing of the drill stock while it is supplied with a mixture of No. 4 emery and water or emery and turpentine. The pressure on the drill stock should be light, and the tube must be lifted frequently to allow a fresh supply of emery to reach the surface being cut. This device makes a hole in the glass in a short time.

If a larger aperture is desired the glass is first drilled in the manner described, and enlarged by careful cutting with a diamond.

The Stove Trade.

The annual convention of the National Association of Stove Manufacturers was held at Saratoga, N. Y., June 19. We take the following from the address of the president, Mr. Geo. H. Barbour: I have reason to believe that the spring trade, which has just passed, has been anything but satisfactory to many of us. Under such conditions will it not prove profitable to consider briefly the causes and see if we can point out some of the remedies? My first would be that merchants may have carried over a larger stock of cooking stoves and ranges from fall purchases than we may have estimated.

Another, and perhaps the main, cause of a general shrinkage is the growing sale of gasoline stoves, for which we do not make sufficient allowance, and those of us who do not manufacture or sell this class of goods should take this into consideration. Allowing that the prices of pig iron have ruled low during the past six months, I do not consider this has any essential bearing upon the present condition of business; a reduction of $5 per ton in the price of iron only reduces the cost of a 200 pound stove fifty cents, and seventy-five cents on a 300 pound stove, and even this reduction is more than made up by your yearly outlay on patterns, additional ornamentations, etc. Who of us ten years ago would have thought stove manufacturers would be using ornaments to adorn our stoves at a cost of one to two dollars? But such are the facts to-day, besides largely increased expenses in various ways. In addition to this, the weather has been against general business; but be this as it may, what are the remedies? I can offer but one, as this condition of things I have mentioned is liable to come up at any time. It is this: We, as manufacturers, have got to watch our business all the more closely and endeavor to keep our production well in hand, so that if the demands decrease, we will not find ourselves with large stocks on hand.

I believe this subject of allowances has had a great deal to do in bringing about disappointment to many of us when the results of the year's business have been ascertained. We may sometimes conclude when some good customer asks for a special five per cent discount or for an allowance of freight, with no cartage, etc., to allow it, but let us see what such decisions may cost us in our year's business.

Suppose Mr. A. has a business whose yearly sales average say $600,000. He is anxious to largely increase his business, he wants to swell the volume up to $900,000, and concludes, as an experiment, to reduce his prices five per cent; just see what this means; if he should only sell $600,000 worth, it would cost him $30,000, and if he sold $900,000 worth, $45,000.

The first named amount means ten per cent on a capital of $300,000, and the second amount fifteen per cent. Now, is there any member present who believes that any stove manufacturer in this country could do business many years on any such a basis? I think not.

Now, just consider for a moment the reverse of this state of things, that on the above amount of sales he tries to get five cent better prices; see what a nice profit it is of itself.

THE so-called antique oak is ordinary American oak sawed in a peculiar way and stained to look like the old English oak.

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THE RETSOF SALT MINES AT GREIGSVILLE, N. Y.

BY S. L. SHELDON.

The Retsof salt mines are situated in the southern part of the town of York, Livingston County, N. Y.

The name under which the works are conducted is The Retsof Mining Co. This company was formed in New York City, under the able management of Mr. J. W. Foster, after whom it was named, the name of the mine being the word "Foster" spelled backward.

The great undertaking of channeling for salt was commenced in the fall of 1884. A whole million was expended to accomplish the work, which occupied about a year and a half. Now, however, these mines yield bountiful returns, being one of the best paying industries in the country.

Five hundred tons are taken out daily and sent to all parts of our Union; to the West, for salting cattle; to the East, for making soda ash; to New York, for statuary; and to many other places, for miscellaneous uses.

The supply seems to be inexhaustible. It is claimed that it will last for a thousand years.

In the vicinity of the mines a whole village of wooden huts and houses have been constructed, also boarding houses, stores, and offices have turned the once desolate place into busy bustle. In the midst of all rises a huge tower, which is the head house or entrance to the mines, and also serves as an elevator by which the salt is conducted into great chutes and store houses. At the east of this tower are the boiler and engine rooms, where twelve boilers, with a capacity of nine hundred and sixty horse power, furnish the force to run the powerful machinery. To run the twenty foot drum on which the cable is wound requires three hundred horse power. To run the blower, crusher, air compressor, and electro-dynamo also requires powerful engine power. Two hundred men are employed about these mines. Most of these are Italians.

At present the mines are reached only by one shaft, although the second shaft is down about two hundred feet. This entrance is a vertical shaft, 16 by 20 feet and 1,185 feet deep. It is provided with two cages, drawn up and down by cables, and these are so arranged that when one is ascending, the other is descending.

The sensation of descending into the mines is somewhat peculiar. For the first five hundred feet the descent is natural, but for the remaining distance one seems to be ascending. The descent to the mines, which are about 1,085 feet deep, occupies about a half minute.

At present the mines are located in the upper stratum. There are two strata of salt, the first about 9 feet thick, the second, separated by 12 feet of rock, is about 60 feet thick. Excavation is commenced at the top. Then, of course, when the second stratum is being worked, supports will be left at different points, so that there will be no danger.

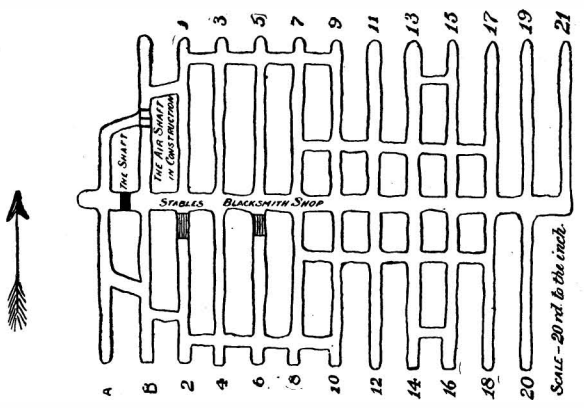
The mine, which has been worked about three years, presents mainly such an appearance as is seen in the diagram, except the representation of numerous cross cuts, now all the time being excavated. The cross cuts represented in the diagram are those through which the rail cars run.

The main gangway extends due east about a quarter of a mile. This is about nine feet high and from four to eight yards wide. Leading off on either side there are 25 chambers at right angles to the gangway, on the north 13, on the south 12. These chambers extend about 30 rods on either side the gangway and are nearly as large as the gangway. The chambers, as buildings of a city, are designated with even numbers on the one side and odd numbers on the other.

The shaft enters the mine at the west of the main gangway, while a little to the north there is an air shaft in construction. Situated in No. 2 are the mule stables, which can accommodate 15 or 20 mules. In No. 6 is the blacksmith's shop. As this stratum is undulating and slopes toward the west, so also does the mine. It is calculated that half as much salt will be left in the pillars as there is taken out, *i. e.*, one-third of the salt will be left for support.

The process of loosening the rock salt from its firm bed is accomplished by blasting. Holes made into the salt with air drills are filled with dynamite, which is exploded by electricity. Then the loose salt, on cars holding about four tons, is drawn to the shaft over a railroad by mules. At present eight mules are employed in hauling the salt. They are kept in the mine all the time, either in the stables or in the barnyard. Nearly one hundred men are employed in the mine, either as foremen, mule drivers, miners, or their assistants.

In the mine the air is quite pure. This condition is



A DIAGRAM OF THE INTERIOR OF THE MINE.

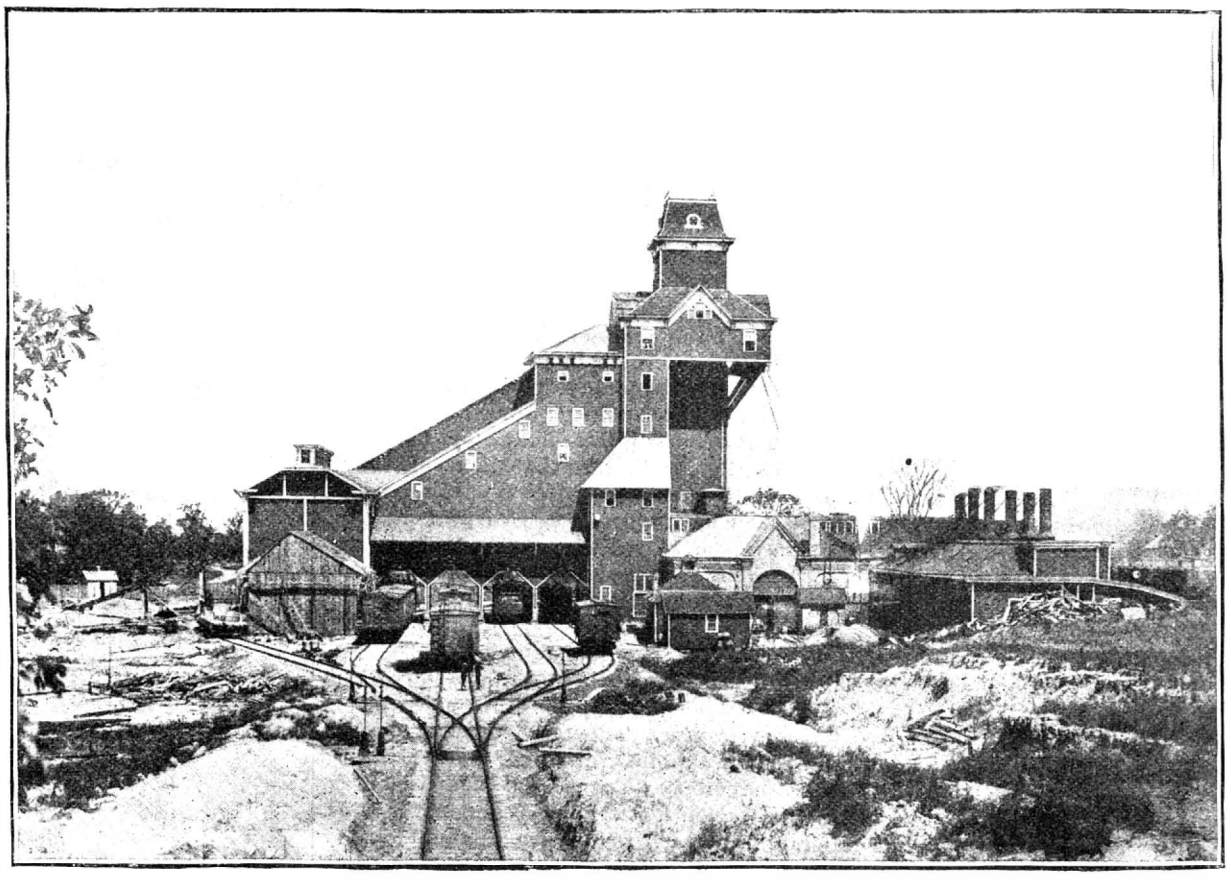
obtained by drawing out the foul air and forcing fresh air in. The air is dry as well as the mine, and has a chloric smell and a saline taste. The temperature is about 60° Fahr. The most noticeable feature to a novice is its darkness and absolute stillness. It has a peculiar silence of its own. All disturbances, elemental and otherwise, which prevail in the open air are unknown and unfelt. The nervous person can there feel secure from the feeling of alarm which a thunder storm excites.

The miners use tallow candles to dispel the depressing darkness, the foremen, drivers, and shovelers use kerosene lamps, while the poor mules have to stumble around in the dark.

One of the strangest sights to a visitor is the blacksmith's shop under ground. It is a very convenient and important feature of the mine, however, and Vulcan has a busy time indeed shoeing mules and sharpening the miners' drills.

The mine seems to be supplied with all modern conveniences. Among them is a telephone where one can converse with the superintendent above, an air whistle used as a signal for commencing and quitting work. There is also a system of pipes running to the different chambers which supplies the drills with compressed air.

The largest part of the salt taken out of the mines is of a dark gray color, and is claimed to be purer than that of a lighter color, being free of magnesia. Other portions of salt are of a reddish cast, while occasionally clear crystals the size of a man's hand are obtained. These crystals are found next to the rock, and are fastened so tightly to it that they are usually destroyed in separation. The crystal salt is chiefly found on the north side of the mine.



THE RETSOF SALT MINE, NEW YORK STATE.

Persons contemplating building will find it to their advantage to subscribe for the Architects and Builders Edition of the "Scientific American." $2.50 a year. Single copies 25c.

Generous Gift for a Great Photographic Telescope.

Dr. Edward C. Pickering, director of Harvard College observatory, sends us a circular stating that the astronomical observatory of Harvard College has received from Miss C. W. Bruce, of New York, a gift of $50,000, to be applied "to the construction of a photographic telescope having an objective of about twenty-four inches aperture with a focal length of about eleven feet, and of the character described by the director of the observatory in his circular of November last; also to secure its use under favorable climatic conditions in such a way as in his judgment will best advance astronomical science."

This instrument will differ from other large telescopes in the construction of its object glass, which will be a compound lens of the form used by photographers and known as the portrait lens. The focal length of such a lens is very small compared with its diameter, and much fainter stars can be photographed in consequence. The advantage is even greater in photographing nebulæ or other faint surfaces. Moreover, this form of lens will enable each photographic plate to cover an area several times as great as that which is covered by an instrument of the usual form. The time required to photograph the entire sky is reduced in the same proportion. A telescope of the proposed form, having an aperture of eight inches, has been in constant use in Cambridge for the last four years, and is now in Peru photographing the southern stars. It has proved useful for a great variety of researches. Stars have been photographed with it too faint to be visible in the fifteen inch refractor of the observatory. Its short focal length enables it to photograph as faint stars as any which can be taken with an excellent photographic telescope having an aperture of thirteen inches. The eight inch telescope will photograph stars about two magnitudes fainter than can be taken with a similar instrument having an aperture of four inches. A corresponding advantage is anticipated from the increase of the aperture to twenty-four inches. Each photograph will be thirteen inches on a side, and will cover a portion of the sky five degrees square, on a scale of one minute to a millimeter. The dimensions will be the same as those of the standard charts of Chacornac and Peters. The entire sky would be depicted upon about two thousand such charts.

It is very important that the best possible location should be found for such an instrument. In Europe and in the eastern portions of the United States, where nine-tenths of the principal observatories of the world are situated, it is cloudy for a large portion of the year. Great advantages are expected from a location where clouds and haze are seldom seen.

This generous gift offers an opportunity for useful work such as seldom occurs. It is expected that the Bruce photographic telescope will exert an important influence upon astronomical science by the large amount of material it will furnish.

Progress of the Metric System.

At a recent meeting of the French Academy of Sciences, M. De Malarce, speaking of the extension of the metric system of weights and measures, gave some interesting figures. In 1887 the aggregate population of the countries in which the metric system was compulsory was over 302,000,000, being an increase of 53,000,000 in ten years. In 1887, in countries with a population of close on 97,000,000, the use of the system was optional; and the countries where the metric system is legally admitted in principle and partially applied (as in Russia, Turkey, and British India) had, in 1887, a population of 395,000,000, being an increase of 54,000,000 in ten years. The increase is due to the growth of population in countries which had already adopted the system and to its adoption by new countries. The systems of China, Japan, and Mexico are decimal, but not metric. The metric system is thus legally recognized by 794,000,000 of people, and the three last named countries have a population of about 474,000,000. So that only about 42,000,000 of inhabitants of the civilized world have systems which are neither metric nor decimal.

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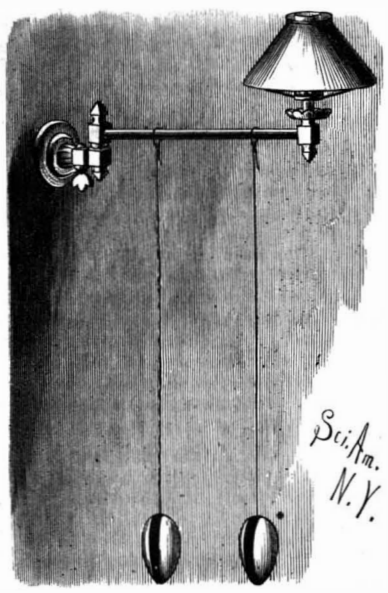
SIMPLE SCIENTIFIC EXPERIMENTS.

EXPERIMENTS WITH EGGS.

Some of the phenomena of fluid friction may be beautifully shown by very simple experiments devised by Sir William Thomson. The materials necessary are two eggs—one raw, the other hard boiled; two rubber bands of such a size as to clasp an egg firmly when slipped on lengthwise; two thin steel wires, about the size of those sometimes used as E strings on guitars; and a mirror or a large plate, or other smooth surface, with a ledge around it to prevent the eggs rolling off.



From a gas fixture, or other convenient support, the two wires are hung, and to the lower end of each one is fastened one of the rubber loops. Into these loops the eggs are slipped, with their long axes vertical, as shown in the figure. Grasping one egg in the fingers of each hand, they are gently turned once or twice round and then let go. The eggs show a surprising difference in behavior. The boiled egg keeps twisting to and fro, after the manner of a torsion pendulum, while the raw one comes almost immediately to rest. The explanation is easy. The hard boiled egg, being rigid throughout, turns as a whole, while the raw egg, being soft inside, has only its shell moved by the torsion of the wire, the contents remaining stationary, because of their greater inertia. The shell is thus made to rub to and fro on its contents, and being very light, is soon brought to rest.

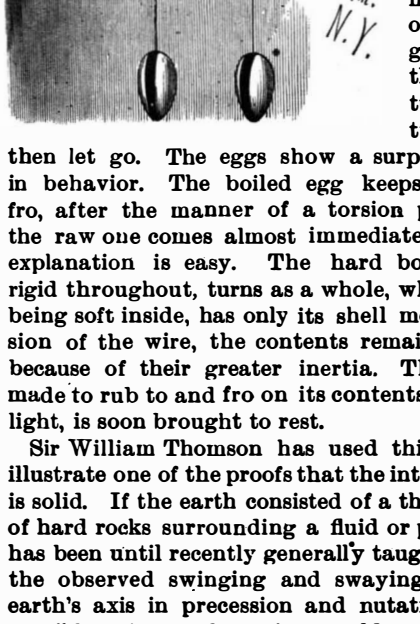
Sir William Thomson has used this experiment to illustrate one of the proofs that the interior of the earth is solid. If the earth consisted of a thin shell or crust of hard rocks surrounding a fluid or pasty nucleus, as has been until recently generally taught, he says that the observed swinging and swaying motions of the earth's axis in precession and nutation would be impossible. Any such motion would soon be stopped by interior friction.

Place the eggs on the mirror or plate and try by a sudden twist with the fingers to spin them on end like tops. With the boiled egg one readily succeeds, but the raw egg will hardly make a single rotation before it falls on its side. The finger twist has merely moved the shell, the inside remaining at rest. Professor Mendenhall has remarked that this experiment furnishes a solution to Columbus' problem—how to make an egg stand on end: first boil the egg hard, and then spin it.

The third experiment is the one that occasions greatest surprise. The boiled egg is spun on its side on the glass, and the palm of the hand is then gently brought down upon it for an instant. The rotation, of course, stops at once. But when the same thing is tried with the raw egg, as soon as the hand that stops it is removed, its rotation begins again. In this case, when the shell is stopped, its fluid contents remain in motion, and, rubbing against it, set it in motion when the hand is taken away. It astonishes one to find how long the egg may be held still before this effect stops!

SMOKING AN EMPTY PIPE.

A neat adaptation of a familiar chemical experiment is now being shown by traveling conjurers. The performer comes forward with a common clay tobacco pipe in each hand, and after exhibiting them and blowing through them one at a time, to show that they are empty, puts them mouth to mouth, as in the figure, and at once proceeds to draw volumes of smoke from them. The merest tyro in chemistry will at once rightly guess that one of the pipes is slightly moistened inside with hydrochloric acid and the other with ammonia, and that the clouds of smoke are merely fumes of the salt ammonium chloride formed by the combination of the vapors of the two chemicals.



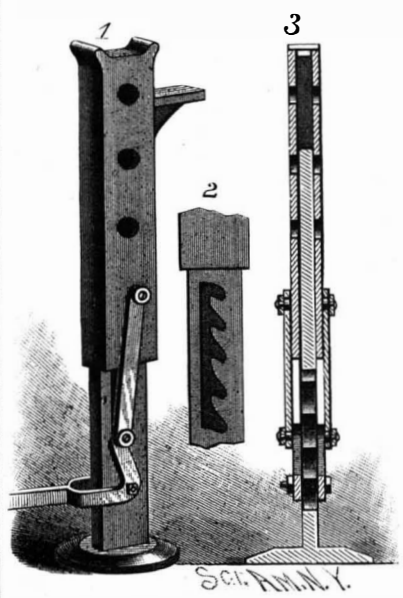
An effective way to show the same experiment to a class is to blow across the mouths of two bottles containing strong ammonia and hydrochloric acid, and placed in line with the lips. A large room may thus be filled with dense fumes in a few minutes. A. B. P.

The Making of Diamonds.

The practical production of the diamond by artificial means has been the theme of a great deal of thought and a good many experiments, but up to this time it has eluded all the efforts of the experimenters, though carbon crystals closely approaching the gem have more than once been secured, while many persons still think it is merely a matter of time, and not a long one at that, when this secret will have been wrenched from nature. In some recent experiments on the effect of high temperature and pressure on carbon, by C. A. Parsons (*Journal of Chemical Society*), carbon rods were surrounded by benzine, paraffin, treacle, chloride or bisulphide of carbon, and submitted to great pressure in a hydraulic press, the rods being meantime heated by passing an electric current through them. In some cases a considerable amount of gas was evolved, and a soft, friable deposit of carbon produced. In no case was the density of the carbon increased. When the rod was surrounded with silica the latter fused, and the rod was largely converted into graphite; the same occurred with hydrated alumina in lime or magnesia, the rod being rapidly destroyed with evolution of gas. With layers of coke, lime, and silica, the rod was rapidly corroded, and was found after the experiment to be coated with a coke-like layer of great hardness, sufficient to scratch rock-crystal and ruby and to wear down the cut facets of a diamond. It resists the action of a mixture of hydrofluoric and nitric acids.

AN IMPROVED LIFTING JACK.

The accompanying illustration represents a device more particularly designed as a lifting jack for carriages, which has been patented by Mr. J. Merritt Smith, of Greenwich, Conn., Fig. 1 being a perspective and Fig. 3 a vertical sectional view. The vertical stationary post or standard of the jack is a solid flat bar having a vertical slot, in one edge of which is a series of downwardly inclining branch slots or pockets, as shown in Fig. 2, the lower walls of these pockets forming rests or supports for the fulcrum pin of the operating lever. The hollow bar or case constituting the lifting upright of the jack slides up and down this stationary post, and is connected by opposite side links with the curved inner upper end of the operating lever, the fulcrum pin of which is placed in any one of the notches or branch slots of the standard, according to the height the lifting upright is desired to start from. The operating lever has a stop, in the slot receiving the stationary post, so that when the lever is fully down, the side links connecting it with the lifting upright will be in an approximately vertical position, or so that the line of resistance may be a trifle on the inside, to prevent shifting of the fulcrum pin, thus making the jack automatically lock itself when raised.



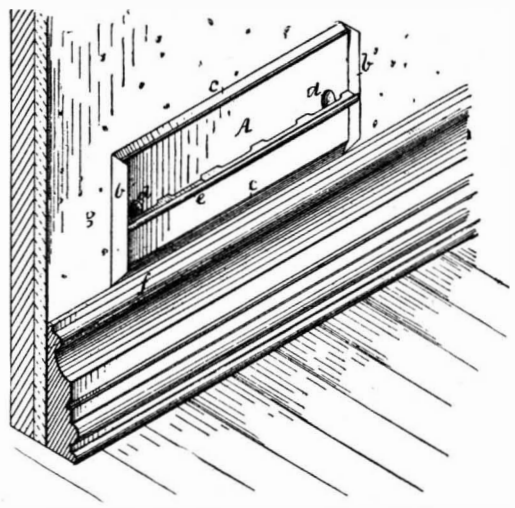
SMITH'S LIFTING JACK.

Peanuts.

According to a correspondent of the New York *Evening Post*, 3,200,000 bushels of peanuts are consumed in this country every year. They come chiefly from Virginia and North Carolina, although Tennessee also produces a small crop. "Peanuts are planted at corn-planting time. Each kernel produces a running vine, like crab grass, and each root produces about twenty pods. When ripe, the plow is run through the loamy soil, on a dry day, just before frost. The nuts are dried and shocked up like corn to keep dry before housing. When marketed, they go to a cleaner, where they are put through steam power machines and polished, after which they are graded according to size and variety. This year there is but two-thirds of a crop, and they are higher in price than since 1884. The crop begins to come into the market about the first of September. The Virginia nut is the largest and finest. The Wilmington is a smaller sort, and the Spanish nut, a still smaller variety, is one whose kernels peel perfectly clean, thus making it valuable for confectionery."

AN IMPROVED WALL PAPER PROTECTOR.

A hand device to hold against the wall of a room when the base boards, door frames, etc., are being washed, to prevent soiling the paper, and allow the cleaning to be done close up to it, is illustrated herewith, and has been patented by Mr. Frederick W. Woodhull, of Lincoln University, Chester County, Pa. The body of the protector, A, is preferably made of sheet metal, with its ends, *b b*, turned outward or back, and its longitudinal marginal portions, *c c*, preferably set

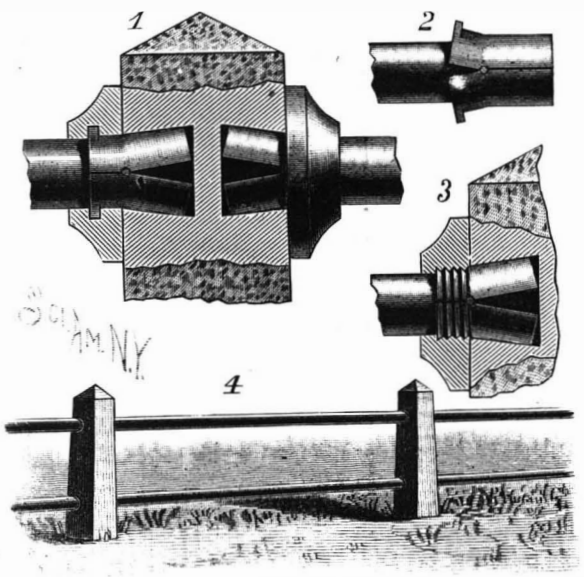


WOODHULL'S WALL PAPER PROTECTOR.

inclining outward from the face of the body. Two indentations, *d d*, are made in the body from its back, forming partly spherical protuberances on its face, which rest on the paper to be protected, their form preventing injury, and giving the protector a slight pitch, so that its longitudinal margin will fit close to the woodwork. Upon the back of the body and extending its whole length is a handle, *e*, soldered or otherwise suitably attached. It is said that preparations are being made to manufacture these protectors in large quantities. See business and personal column.

AN IMPROVED FENCE.

The accompanying illustration represents a fence more especially designed for inclosing cemetery lots, but also well adapted for use in connection with lawns, gardens, and pleasure grounds, etc. It forms the subject of a patent issued to Mr. Henry E. Macrea, of Hudson, N. Y. Fig. 4 represents a fence constructed according to this invention, Fig. 1 being a broken and partly sectional elevation showing the manner of connecting the metal rods or tubes with the stone post. The post has tapering recesses or sockets of circular dovetail shape in its opposite sides, into which are inserted first one and then the other of two loosely fitting half sleeves encircling the rods or tubes, as shown in Fig. 2, each half sleeve rocking upon a pin or bolt passing transversely through the rod or tube, such pin or bolt engaging with notches in the faces of the half sleeves. An outer flange or nut is made to fit the rod or tube freely, and also to receive the outer end portions of the half sleeves, when these portions are brought together, as shown in Fig. 1, whereby the inner end portions of the half sleeves are spread outward within the tapering sockets, forming locking devices. Fig. 3 shows a modified form of construction in which the outer flange or nut is screwed on to the half sleeves to hold the latter in locked position. This invention is also applicable to fences or railings in which metal uprights or rods are secured at their lower



MACREA'S FENCE.

ends in stone sills, or may be used in fences in which the posts or supports are of other material than stone.

THE usual thickness of veneers for furniture is from one-eighth to one-fortieth of an inch, but as a curiosity they are cut as thin as 160 to an inch.

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RECENTLY PATENTED INVENTIONS.

Engineering.

FEED WATER HEATER AND CONDENSER.—John Willenbrink, New Richmond, Ohio. By this invention the water supply pipe connecting with the pump discharging into the boiler is made with a number of vertical pipes opening into it, and connected with the exhaust pipe of the engine, the construction being simple and effectively utilizing the exhaust steam to heat the feed water.

STEAM WHISTLE.—James R. Eldridge, Yarmouth, Nova Scotia, Canada. This invention provides a sound deflector, consisting of a casting, either solid or hollow, having a curved under surface, whereby the sound waves will be deflected horizontally over a large area, the device being of simple construction, and designed to be expeditiously attached to or detached from any form of whistle.

SAFETY PILOT FOR LOCOMOTIVES.—Norman S. Mussey, New York City. This is an apparatus having telescoping air chambers and telescoping tubes, operated by steam or compressed air, and attached to the front of the train by which it is propelled, the apparatus being so arranged that in case of collision it will act as a collapsible cushioning buffer to remove the shock of collision from the train.

Railway Appliances.

CAR COUPLING.—Edward E. Miller, Avenue City, Mo. The drawbar has a side opening and the end of a horizontal trip lever projects into the link throat, there being combined therewith a vertical lever with a hook at its upper end and a horizontal hand lever fulcrumed to the end of the car, having on its inner side a loosely connected coupling pin, whereby cars may be automatically coupled, and going between them for the purpose is avoided.

CAR COUPLING.—John M. Burden, Huntsville, Ky. This is a device by which cars may be coupled by simply securing the coupling bar in one drawhead and forcing the cars together, when the free end of the bar will enter the other drawhead and be engaged thereby, the invention covering various novel details of construction and combinations of parts.

Mechanical.

MECHANICAL MOVEMENT.—George W. Thomas, Ogallala, Neb. A pitman consisting of two grooved bars connected by teeth with each other is combined with a gear wheel on a main shaft meshing into the teeth, while crank disks engage by their crank pins the grooves in the bars of the pitman, the device being specially intended for reversing motion and applying power in a direct manner throughout the length of the stroke.

WATER MOTOR.—Louis P. Santy, Clements, Kansas. This motor consists of two endless chains passing over drums located on opposite shores, with buckets of special construction pivoted on the chains and operated on by the force of the water, and is especially adapted to be used under waterfalls, in the currents of streams, etc.

LUBRICATOR FOR SPINNING MACHINERY.—Lazarus B. Sanford and Thomas Grisenthwaite, Fall River, Mass. This is a lubricator hinged on one of the links of the tension device, and has an aperture discharging into a concave recess formed on the inside of the foot resting on the neck of the roll, thus supplying the necessary lubricant to the top rolls while cleaning and clearing the rolls and forming a smooth round lap on the top clearer for mules.

Agricultural.

LISTER AND DRILL.—William A. Loughry, Odessa, Neb. This is a combined machine by which the usual subsoil plow is dispensed with, and the edge of the trench is left at an angle instead of perpendicular, so that grass will not soon appear at the joint of the turn of the furrow, there being combined with the listing plow and drill concave and inwardly curved blades, adjustably secured to the inside of the mould board.

ROLLER COLTER.—Sidney Cook, Orlando, Fla. This is a plow colter to cut weeds, etc., in advance of the shaft, the colter head having rearwardly extending arms secured at their forward ends thereto, and the colter being journaled in the rear of these arms, while weed-depressing arms are secured to the colter head and curved downward and rearward under the colter arms.

Miscellaneous.

REST FOR PACKING HATS.—James W. Seymour, Brooklyn, N. Y. This is a device in which hats may be expeditiously and conveniently placed, and, when packed, will ride independently of each other, consisting of opposed tubular columns having upon one face transverse outwardly extending tongues, the device not marring or injuring the hats, and the hats being so held that the device may be upturned without danger of spilling the contents.

JOINT FOR HOLLOW SHELLS, ETC.—Lyman White, Waterbury, Conn. This is a joint for such articles as house boilers, ammonia receivers, soda tanks, etc., the opposing cylinder sections having their contiguous ends turned inward, in combination with an interior peripherally grooved tie ring and an exterior locking ring, whereby a simple and durable joint may be conveniently and expeditiously made.

ELECTRIC HORSE DISCONNECTOR.—Georgo A. Coulter, Omaha, Neb. This invention covers an apparatus for automatically releasing horses from their stalls in the fire engine house by the electric impulse on the fire alarm circuit, and consists in the peculiar construction and arrangement of the devices for locking and opening the stall doors and electrically tripping and releasing them.

SOLDERING CLAMP.—Henry C. Atkinson, Scottville, Ky. This is a machine for use in soldering together the sections to form eaves troughs, and also for soldering the sections of spouting, the machine consisting of a body piece with a groove in one side and in the other side a trough-like cavity with a stop, seat, or bearing, at one edge of the cavity, and a presser at the opposite edge.

WINDOW SCREEN.—William J. Horton, Halifax, Nova Scotia, Canada. The lower end of the screen, of fabric or woven wire, is nailed to the window sill, and its lateral edges are connected with and slide on rods fixed vertically on the inner sides of the window frame, the upper edge of the screen being secured to the under side of a wooden cross bar detachably connected with the sash, the screen being drawn out and stretched when the sash is raised, and partially folded when the sash is closed.

SEWER PIPE.—John A. Missud, New Orleans, La. This sewer pipe is provided with a small supplementary pipe on its lower inner surface throughout its length, such supplemental pipe being cast integral with the main pipe, and provided with frequent perforations, whereby the main pipe may be effectively flushed when desired to remove sediment.

WASTE PIPE COUPLING.—William H. H. Davis, Philadelphia, Pa. This coupling consists of a sectional or two-part malleable iron clamp plate, each part provided with a lug for the passage of a bolt by which it is held to the cupped end of a water pipe fitting the tapering nozzle of an ordinary kitchen sink, wash bowl, etc., allowing easy connection or disconnection, with economy of time, labor, and material.

BOOT OR SHOE LAST.—Arthur M. Leighton, Port Townsend, Washington Ter. This last comprises a heel piece, foot piece, and novel connections between these parts, the foot piece being pivoted between its ends, so that it can be turned end for end, and being shaped differently at its opposite ends so it may fit different shaped shoes when adjusted to correspond therewith.

ADJUSTABLE LAST.—Arthur M. Leighton, Port Townsend, Washington Ter. This invention covers an improved adjustable cobbler's last, designed to be readily adjusted to closely fit any size of boot or shoe, whether with a pointed or wide toe, while it can be readily lengthened or shortened as desired, the last being strong and simple in construction.

WINDMILL POSTS.—Leonard J. M. Nehf, Sutton, Neb. This is an anchoring attachment by which such posts may be firmly fixed in the ground without digging the large holes heretofore required, and consists of two leg portions, with a yoke for holding their upper ends apart, the legs having a pivotal bearing in the yoke, while a wedge is forced between the lower ends of the legs to spread them apart.

GATE.—Amon W. Chilcott, Mattoon, Ill. This is a gate adapted to be opened or closed without dismounting from the horse or vehicle, and automatically locked in either opened or closed position, being a hinged gate with a lever pivotally connected to it at one end, a triangle hinged at its base and pivotally connected at its apex to the lever, with a weight on the projecting end of the lever beyond the apex of the triangle.

CEMENT.—Carl Straub, Syracuse, N. Y. This is a special composition, in which is used such gypsum as found in Onondaga and Cayuga Counties, N. Y., sulphuric or muriatic acid being used therewith, and a retarder, such as glue or oil, with the calcined calcareous base and silicate of potash or natron, the materials being compounded in proportions and after the manner described.

THILL COUPLING JACK.—James M. Smith, Greenwich, Conn. In this jack the strap-like clamp is combined with a lever having a changeable fulcrum to operate on the opposite side of the axle, a single movement of the lever serving to keep the jack to its hold without a continued strain or pull, thus making the jack automatic, and affording increased facilities for adjustment.

PIPE DAMPER.—Mark J. Liddell, Mount Pleasant, Mich. This is a damper applicable to the pipe or draught fine of any stove, heater or furnace, and consists of two plates pivoted at contiguous edges, with a latch device connected to the plate pivots and adapted to hold the plates at any required adjustment, the device being simple, inexpensive, and efficient, affording perfect control of the draught.

LADDER PLATFORM BRACKET.—Lewis B. Laskey, Dover, N. H. This is a device which may be securely fastened to the rounds on any part of a ladder, and is designed to afford an easy and firm footing for masons, painters, etc., or to facilitate the picking of fruit, the device being readily placed on a ladder standing at any angle, and so made that it can be folded up when not in use.

FOLDING SOAP BOX.—Isabella B. Jones, New York City. This a box for holding soap conveniently at the side of a pail or other vessel, and is made with a body of sheet or cast metal or waterproof paper, to be inexpensive and neat-looking, the body being open at one side and having a lower drip chamber, while a soap tray is hinged to the body, and has a chamber holding the drip when the tray is folded to the body.

QUILTING FRAME.—Uriah E. Miller, Heilig's Mill, N. C. This is an attachment designed to be readily connected with and disconnected from a sewing machine, while being easy to handle and efficient in operation, the invention covering various novel arrangements and combinations of parts.

PHONOGRAM RECEIVING BOX.—Harry F. Searle, Brooklyn, N. Y. This is a box designed to receive wax phonogram cylinders, and adapted for conveniently storing and fitting the phonogram and prevent it from being injured on its delicate periphery while being stored and transported, the box having a cover and a circular offset held concentric in the box, on which the cylinder is placed. The cover locking the cylinder is placed on the offset.

PERFORATING TOOL.—William Fallon, Newburg, N. Y. This is a marking wheel consisting of a disk having a series of solid pins upon the periphery, and having a recess in the outer end producing a cutting edge, the tool being pivoted in a shank having a shoulder piece swiveled to its upper end, whereby pressure may be exerted without inconvenience to the operator.

PHOTOGRAPHIC CAMERA.—Erastus B. Barker, New York City. This invention relates to magazine cameras in which a series of sensitized plates are stored one in rear of the other for successive use, and provides for the ready adjustment of the plates to their places, releasing them after exposure and throwing them over into the receiving box, while light is effectually excluded from the plates except at the time of exposure to take the image.

PHOTOGRAPHIC PAPER ROLL HOLDER.—Erastus B. Barker, New York City. Combined with and detachable from the holder is a spring carrier made to form bearings for the ends of the roller, and to throw tension on the roller at its ends, with other novel features, whereby the paper may be conveniently rolled upon one roller and unrolled from the other to make a series of successive exposures throughout the length of the sensitized strip.

ALBUM.—Christian Jaeger, New York City. This is a double-backed book in which the leaves are secured to the two backs to interlock and support each other when the book is closed, the upper cover being by preference centrally and longitudinally divided, making an album not liable to get out of shape, and in which there will be no undue strain upon the back.

SCIENTIFIC AMERICAN BUILDING EDITION.

AUGUST NUMBER.—(No. 46.)

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3. Page engraving of the new and elegant Trinity church at Tiffin, Ohio, designed by F. K. Hewitt, architect.
4. A New England mansion. W. B. Tubby, New York, architect. Perspective elevation and floor plans.
5. Elevation in perspective and floor plans of a cottage at Jersey City Heights. Cost twelve thousand dollars.
6. A cottage recently erected at Bridgeport, Conn., at a cost of two thousand three hundred dollars. Floor plans and perspective.
7. A handsome country residence at Belle Haven Park, Greenwich, Conn. Cost eleven thousand dollars. Perspective and floor plans.
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NEW BOOKS AND PUBLICATIONS.

SEVENTH ANNUAL REPORT OF THE UNITED STATES GEOLOGICAL SURVEY. J. W. Powell, Director. Washington: Government Printing Office. 1888.

Although this report only covers the work of the department for the fiscal year 1885-86, one feels amply compensated for the seeming delay in its publication by the care and thoroughness everywhere manifest in the pages of this magnificent volume, with its splendid maps and plates and rich typography. In its geographic division the department has undertaken a topographic survey of the whole country, of which but a little more than a commencement has been made, but the work is eventually designed to be the basis for all other maps. Among the principal papers in the volume are: "The Rock Scorings of the Great Ice Invasions," by T. C. Chamberlin; "Obsidian Cliff, Yellowstone National Park," by Joseph P. Iddings; "Geology of Martha's Vineyard," by Nathaniel S. Shaler; "Classification of the Early Cambrian and Pre-Cambrian Formations," by R. D. Irving; "Structure of the Triassic Formation of the Connecticut Valley," by William Morris Davis; "Salt Making Processes in the United States," by Thomas M. Chatard; "Geology of the Head of Chesapeake Bay," by W. J. M'Gee, with a valuable report on the "Mineral Resources of the United States," by Mr. Albert Williams, Jr. A limited number of these volumes, and of other publications of the Survey, are kept for sale to the public, at their cost price, and applications therefor should be addressed to the Director of United States Geological Survey, Washington, D.C.

DAUDET'S LA BELLE-NIVERNAISE. The story of a river barge and its crew. Edited by James Boielle, B.A., Senior French master in Dulwich College. Boston, U. S. A.: D. C. Heath & Co. publishers. Paper. Price 30 cents.

This is one of Alphonse Daudet's prettiest short stories, and pictures the life of a family living on the rivers and canals of France. Daudet's French is peculiar and full of idioms, and the editor has published an appendix of explanatory notes and full translations of the idioms. The book is intended principally for the use of schools or colleges.

DARWINISM. An exposition of the theory of natural selection. By Alfred Russel Wallace. London and New York: Macmillan & Co. 1889. Pp. xiv, 494. With diagrams and illustrations. Price $1.75.

One of the most prominent of the advanced school of Darwinists presents in this work the arguments for the truth of the theory of evolution. The definition of species, as essential to the plan of the author, is first given. Then their struggle for existence among animals and plants is discussed. The variability of species and changes in animals, wild and domestic, with natural selection and the doctrine of the survival of the fittest, come next in order. The work goes on in this way, giving an admirable exposition of the difficulties as well as of the more successful portions of the theory. The concluding chapter is devoted to man, and while the author accepts the doctrine of the evolution of man's bodily nature, he rejects it for the intellectual, and advocates the hypothesis of a spiritual world. This conclusion, coming from so pronounced a Darwinist, is of special interest as indicating the limits now being imposed by advanced thinkers upon evolution. A portrait of the author, forming the frontispiece, is of interest on account of his high standing in the biological world.

ELECTRO-METALLURGY, PRACTICALLY TREATED. By Alexander Watt. London: Crosby, Lockwood & Son. 1889. Pp. x, 278. Price $1.40.

The title and author's name sufficiently vouch for the scope and quality of this book. To those who wish a thoroughly practical epitome of the art, and who do not feel disposed to go into the detail of the larger manuals, this addition to Weale's series may be confidently recommended. It is illustrated with a number of cuts which are applicable to its purpose and increase its value.

THERMODYNAMICS OF THE STEAM ENGINE AND OTHER HEAT ENGINES. By Cecil H. Peabody. New York: John Wiley & Sons. 1889. Pp. xviii, 470.

Professor Peabody, of the Massachussetts Institute of Technology, in his preface announces that he proposes to offer a text book for students. But the high character of the work, its plain and practical nature, are such as to make it of value to all who desire to study the last views on the great question of thermodynamics. Much of the space is devoted to the more practical considerations, as of actual tests, methods of testing, etc., but the opening chapters give a good review of the theory, utilizing the calculus where required.

TWENTY YEARS WITH THE INDICATOR. By Thomas Pray, Jr. New York: John Wiley & Sons. Pp. 284. 8vo. Price $2.50.

This is the only book, we believe, that has ever been published dealing exclusively with the use of the indicator for the proper calculation of the work done by the steam in steam engines. It is a practical text book for the engineer, while it has no complex formulæ, and explains the subject in a manner to be readily understood by any student or mechanic. It is fully illustrated, and contains rules as to the best way of running steam engines to get the most economical results, how to adjust valves and valve motions correctly, how to compute power by planimeter and other methods, etc., with many tables and hints. The matter of the book has been gathered from the very wide personal experience of the author ever since the commencement of the use of the indicator, and it is eminently adapted to be of practical service alike to the engine owner and the working engineer.

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Notes & Queries

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Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(1065) J. N. W. asks for a receipt for making an ale yeast or refer me to a work where I could get it. A. Yeast collects as a solid precipitate during bottom fermentation on the bottom of the fermenting vat. In "Preparation of Malt and Fabrication of Beer," which we can supply for $10, you will find the subject treated in much detail.

(1066) M. V. asks: How much pressure would be exerted in a cylinder 5 inches by 7 inches (5 inches deep and 7 inches diameter), the boiler to contain 300 pounds to the square inch? A. The cylinder would have a pressure of 11,550 pounds on each head, 16,500 pounds on the sides.

(1067) C. R. P. asks: Would you kindly give me a receipt for making violin resin? A. For violin resin boil down Venice turpentine with a little water until a drop cooled on a piece of glass is of proper consistency. During the boiling cold water must be added from time to time. When sufficiently thick pour into cold water, knead well, and when cold break into pieces. Expose to sun until dry and transparent.

(1068) F. N. H.—It is against all sanitary rules and common sense to use a well for a cesspool if there are any wells in use in the neighborhood. One well as a cesspool in a village where the neighboring wells are in use for household purposes may start typhoid fever. The water circulates in the ground, and when the direction of the circulation is known, a deep cesspool may be safe on the leeward or down-stream side of the town.

(1069) C. I. W. Co. ask the cheapest and best preparations for dipping the bottoms of wooden fence posts in to preserve them. A. The best is oil of tar or creosote oil heated to 212°, dipping the post long enough for thorough surface saturation. Coal tar or petroleum is the cheapest. Sulphate of copper and sulphate of iron solution in water, used boiling hot, and chloride of zinc solution in water, are also good. Saturate by dipping in hot solution.

(1070) F. A. McC. writes: We have a ¾ inch iron pipe to run water from the bluff 800 feet to the house. It is filled up to quite an extent with rust. Is there any means of cleaning out a portion or all this rust and allowing the water to run freely again? A. Unscrew the pipe and clean each piece with an iron rod.

(1071) N. A. S. asks how many revolutions a worm would stand without heating. How would it wear, and what kind of metal is best for gearing? A. Worm gear is much used for light work. The turns required for heating depend upon the pressure, size, and speed of the worm. Hard gun metal or steel makes a good worm to run on a cast iron wheel.

(1072) G. W. B., Jr., asks how to polish deer horns. A. Scrub them with a brush and sand to take off the dirt and loose fiber, then polish with rouge and rotten stone and a cloth, and varnish with copal varnish.

(1073) J. B. P. writes: If the moon revolves on its axis once in 28.4 days, and the earth revolves on its axis each 24 hours, why is it that we see only one side of the moon? A. The axis of the moon's rotation, of which you speak, is not within it, but is nearly coincident with the earth's axis. The moon rotates around the earth.

(1074) E. C., Jr.—Coal tar and ground graphite thinned with turpentine make an excellent paint for boiler fronts and pipes in boiler room. The steam pipes for heating should not be painted, or if required, should only have a very thin coat of lampblack and linseed oil. Tin is unfit for roofs of boiler houses. Slate is best. You can make a temporary covering on the tin roof with asphalt and gravel. This will not save the tin, which will soon give out entirely. The cheapest way out of your trouble is to take off the tin and slate the roof.

(1075) J. L. M. asks: What to use to give tin a luster after it is dipped in the hot metal; have been using sal ammoniac water, but it does not give as good luster as I would like. A. The luster on dipped tin work is made by the dipping process, and cannot be made by any chemical treatment afterward. The work may be polished with a brush and whiting with good effect. To dip bright, the surface of the tin bath must be kept perfectly clean with powdered sal ammoniac and skimming. The temperature should also be exactly right for the best effect.

(1076) J. A. B. asks: 1. How the wire solder is made that is sold by street venders and used by holding a candle under the tin where the leak is, and rubbing the solder over it? A. The solder is what is called bismuth solder in the trade. Made by mixing two parts tin, one part lead, one part bismuth. 2. Describe briefly how I could make a small battery for a door bell. A. See battery described in SCIENTIFIC AMERICAN, December 17, 1887, and SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 157, 158, and 159.

(1077) C. J. asks the best way of inclosing a ventilating fan. A. The blades should be very thin and light and inclosed at the periphery with a light band, same width as blades, to which the blades should be fastened. At speed stated (100 revolutions a minute) the fan will deliver about 2,500 cubic feet of air per minute without pressure, and will require from 4 to 6 h. p. to run it. Everything in respect to power depends upon the weight and make of the fan. Your description gives us but little information as to the construction of your fan.

(1078) L. O. H.—The pressure or resistance of air at twenty miles an hour is two pounds per square foot. At ten miles per hour, half a pound per square foot. At the latter rate two square feet will make a resistance of one pound.

(1079) W. G. M. asks: 1. How many feet of one inch pipe in the form of coils connected with a steam dome would be required to generate steam for a four horse power engine, wood fuel, and would you recommend such a boiler? A. It will require 170 feet of one inch pipe as heating surface for a four horse power boiler. See article on pipe boilers, illustrated in SCIENTIFIC AMERICAN SUPPLEMENT, No. 702. We can recommend pipe boilers when properly made, to give free circulation of water. 2. How to estimate the horse power of sails on a windmill. A. The horse power of windmills is computed from the pressure upon the vanes, due to velocity of the wind, the angle of the vanes, and speed obtained, or by application of the Prony brake.

(1080) E. P. asks: What kind of coal ignites the quickest and at the same time makes the largest volume of blaze? A. Cannel coal, such as is used for making gas, is the easiest and most inflammable.

(1081) M. & M. write: We think of erecting a crossway over a river. The span is 300 ft. We have a wire rope 1 in. in diameter, long enough to cross twice; would it be advisable to stretch two strands and hang a walk under, or one strand and hang a car on it? We would like the walk if it would be safe. A. You can make a very substantial foot bridge with the double cable, by giving the cables a deflection of 20 ft. from the level of the piers. Lash slats of pine about 4 ft. long to the top of the wire ropes. Put bracket stays every 10 or 15 feet for rail ropes, which may be ⅝ hemp rope. Place guy ropes enough to steady the bridge from the effect of wind. The 1 in. wire rope, if in good order, is equal to a working strain of 6,000 lb. The distributed load, including weight of rope, slats, guys, and people, should not be over 4,000 lb. for the bridge of two ropes.

(1082) B. I. asks: Is the discovery of natural gas confined to any particular geological formation? And if not, do you think that there is any sound reason why it may not exist in the neighborhood of Piedmont, Va.? A. The Piedmont region of Virginia, including your Bedford County, is not within the geological field of oil-bearing or gas-bearing rocks. The new red sandstone belt, resting upon the primary and tilted gneiss, on its western edge, is conceded to be a barren belt in regard to oil and gas. There is but little doubt that the coal and gas fields have a very close connection. The Triassic coal beds of central Virginia and North Carolina may yet be found an oil or gas locality; but the fact that these coal beds belong to a later geological period than those forming the great interior geological basin is much against any such expectation.

(1083) Barber writes for a receipt for brightening tin bath tubs. Have tried various liquids, but cannot remove the brown color from the tin. A. If ground pumice, soap, and water will not do it, the stain is due to the destruction of the tin, and your only remedy is new bath tubs.

(1084) R. C. H. asks: 1. How hard rubber is made, such as is used for making draughting triangles. A. For India rubber manufacture, we refer you to our SUPPLEMENT, Nos. 249-251, and 252. 2. How transparent celluloid is made. A. For celluloid see answer to query No. 996, in SCIENTIFIC AMERICAN, June 13, 1889.

(1085) G. B. P. asks: If a lady and gentleman meet on the street, who should bow first? A. In this part of the world the lady bows first. In other countries the gentleman bows first.

(1086) C. C. S. writes: How can I tan and remove the hair from a gopher or squirrel skin, to be used in the construction of the telephone described in the SCIENTIFIC AMERICAN, May 18, 1889, page 307? A. Treat it with lime water, or milk of lime, if the first is too weak, and scrape. You must not tan it, but stretch it while wet over the frame.

(1087) J. B. writes: 1. I am engaged in tanning business, and use lime for depilating. But it does not give satisfaction, on account of corroding the wood. I have tried sulphide of sodium (4 per cent sol.), but it seems to evaporate before doing the work. Would like to know what I can use as a body, to prevent the sudden evaporation and not impair the strength of the sodium. A. You may mix milk of lime with it to keep up its strength. Sometimes it is mixed ¾ lb. to the gallon of water, thickened with lime or pipe clay, and spread over the hides, which are then folded and left for some hours. It is a powerful agent, and liable in unskillful hands to do injury. 2. How long should the skins lie before pulling? A. Three or four hours should suffice. 3. Is the solution indicated strong enough? A. You might use it three times as strong. Allow ¾ lb. to a bullock's hide, and *pro rata* for smaller skins.

(1088) A. A. K. asks: Will you please tell me through your columns how many cubic feet of hydrogen gas is required to lift one pound (16 oz.)? A. About 14 cubic feet. The greater the pressure to which it is subjected, the less it will lift.

(1089) N. A. E. asks for the best process for staining a violin, one that has just been made, and has not been shellacked or stained? A. The wood may be stained to suit with aqueous or alcoholic infusion of aloes, annatto, gamboge, turmeric or saffron for yellow; with infusion of dragon's blood or red sanders wood for reds. By mixture, any desired tint can be obtained. Perhaps the better way is to extract the coloring matter with alcohol and add it to the varnish, bearing in mind that in this case each coat of varnish will intensify the color. The first method is said to give a painted effect to the work.

(1090) J. P. E. asks: How can I prepare a button of lampblack to be placed in the circuit of a telephone transmitter, same as is used in some of the Edison transmitters? A. Press it in a die by hydraulic pressure.

(1091) C. W. V. writes: I have some very fine specimens of iron pyrites or "fool's gold," which are badly stuck up with shoemaker's wax. What can I use to dissolve this off? A. Wash off with kerosene oil, using a stiff brush. If this is insufficient, follow it with spirits of turpentine.

(1092) C. A. S. writes: What are the materials used, and in what quantity, in making the preparation for sticky fly paper? A. Melt by heat 1 lb. resin with 3½ oz. linseed oil and 3½ oz. molasses. Apply while hot.

(1093) F. W. S. asks: 1. For a formula for white ink, for writing on ordinary dark and black paper. A. For white ink, use Chinese white, rubbed up with gum arabic water. Or if for blue paper, use a solution of oxalic acid (poison), using a gold or quill pen. The last is an excellent method of writing white on blue, and gives a permanent, ineffaceable record. 2. For making an ordinary dressing for buggy tops, etc.? A. Neat's foot oil is excellent, if only wanted as a dressing. A little turpentine and enough beeswax to give it the consistency of butter when cold may be mixed with it by heat and stirring. One receipt for leather ointment reads as follows: Melt and mix yellow wax, oil of turpentine, olive oil, castor oil, of each 25 parts, and pure boiled linseed oil 50 parts; add with constant stirring 37½ parts pure wood tar.

(1094) W. S. asks: Can you give me the formula for the explosive used on tip of the ordinary parlor match? How is it prepared, and how put on? A. Heat together on a water bath 3 parts red phosphorus, ½ of gum tragacanth, 3 of water, 2 of fine sand, and 2 of binoxide of lead or of red lead. Dip the sticks first into melted stearic acid, and then into above. When dry dip into a solution of gum benzoin 4 parts in alcohol (40° B.) 10 parts.

(1095) A. A. R. asks: Why do we not feel the heat of the sun as much in light-colored clothing as in black or dark-colored? A. The lighter colored clothing reflects more of the sun's heat than does the black or dark-colored. On the other hand, dark-colored clothing is the better radiator, and disposes more quickly of the heat of the body.

(1096) W. A. R. asks: A process for welding iron and cast steel together? A. We know of nothing better than borax and good management. Have the iron sparking hot. Steel bright cherry. Make the weld at first blow.

(1097) F. R. W. asks: 1. In steamboats which way should the steering wheel move, the same as the rudder, or contrary? A. Wheel should move the same way as the tiller, and opposite to the movemen of the rudder. 2. In a side-wheeler, which way should the reverse lever move, the same way as the boat moves, or the contrary? A. Reversing lever should move in the same direction that the boat moves, if convenient, otherwise to suit the necessities of construction. 3. Can we increase the speed of a side-wheeler by lightening her paddles and letting the engine run faster, having plenty of steam? A. The paddle wheels are the fly wheels to the engine. Cannot say that lightening the wheels will give greater speed; better enlarge the wheels. 4. How deep should paddles dip, which are 18 ft. diameter, make 25 revolutions per minute, on 100 ft. boat, and how far apart should the paddles be? A. Paddles should dip 1¾ feet. An 18 foot wheel should have 16 paddles.

(1098) J. G. asks: How to make beeswax about the hardness of sealing wax. Also how to color same red, brown, and black? A. It cannot be hardened. To color it, first bleach it, then incorporate with it dry colors by heat and rubbing; carmine, burnt sienna, and lampblack may be used. To bleach it, roll or cut into thin shavings and expose to sun.

(1099) S. asks: Will you kindly inform me how many pounds of water a dynamo, driven by two horse power engine, will decompose in ten hours? A. It depends on the resistance of the decomposing apparatus. Allowing two volts as the requisite intensity of current to cover this resistance and the electro-chemical decomposition coefficient of water, we obtain 4·899 lb. avds. of water as the quantity that would be decomposed.

(1100) P. C. S. asks what to apply to a refrigerator, that will prevent its scenting food placed therein? It is about six years old, but was lined throughout two years ago. A. Put box with quicklime in it, and replace every few days as fast as it becomes slaked.

(1101) G. L. B. asks: What power would one 5-16 in. stream of water have impinging against a flat or covered surface under 150 in. pressure, and what reactionary power would two streams have under the same pressure in an apparatus like the Barker mill? A. Each stream or jet would be equal to 2¼ horse power.

(1102) C. O. N. writes: 1. Suppose canned fruit, which it is desired to heat to a certain temperature, is placed in an oven, which will be the most effective, to heat from burning coal directly around the oven, or heat by steam let directly into the oven, and which is the most economical? A. We advise steam heat properly applied. 2. Why may not a high metal shaft, properly insulated, be effective for gathering electricity? Might not the Eiffel tower gather electricity in quantities sufficient for lighting or running machinery? A. Any electricity thus collected would be too small in amount to be of any use.

(1103) W. S. asks: 1. Supposing you wanted a private telegraph line, would one wire be sufficient, running between the two places, or would you have to have two to complete circuit? A. A single wire grounded at both ends is perfectly efficient. 2. Would it do to connect the instrument of private line with a battery of another instrument so as to have the one battery work both of the lines? If so, how could it be done? A. It is better to have a separate battery for each line. 3. Would it do to have the ground wire of this private line connected with the ground wire of the other line? A. Yes; if current in both lines was used in same direction. 4. Could you give me any idea how to guard against lightning without a switch board? A. Connect a metallic comb or toothed plate of metal with the ground. Have a similar plate close thereto with teeth facing teeth but not touching, and connect the line to the second plate. 5. Does it strengthen a battery any by putting in it pieces of old zinc instead of blue vitriol? A. No; it exhausts its strength uselessly and interferes with its action.

(1104) J. S. S.—Nickel plating can be given the black oxidized appearance by dipping in a solution of platinum chloride, or by the sulphide of lead process, or by electro plating a thin covering of silver and then oxidizing the silver. Steel polished is cheapest colored by heat, but can be plated and the plating oxidized. See Techno Chemical Receipts, which we mail for $2. Also Workshop Receipts, 1st series, $2.

(1105) A. H. B.—Long balls or shells fired from rifled guns keep their axes parallel with the bore of the gun during their entire flight. Anything that will make a difference in specific gravity between the forward and rear end of a projectile will tend to keep its axis in the line of the trajectory, as is the case with the projectiles of the pneumatic gun, which move with their axes coincident with their trajectories during the whole course of their flight.

(1106) W. W. D. asks the best way of removing the slides or crooks from brass or plated horns when they have corroded and stuck, without marring the instrument or injuring the plating. A. Kerosene oil applied inside and outside will soon penetrate and soften the gum, when the parts can be moved.

(1107) R. P. A. asks: Which travels the fastest—sight, light, sound, thought, or electricity? A. Light and electricity may be said to travel the fastest. Sight and thought only travel in a metaphorical sense.

(1108) J. R. asks how cheap copper jewelry is prepared to appear like oxidized silver. A. Give it a thin coating of silver by simple immersion or by the battery, and apply any desired oxidizing process, such as dipping in solution of sulphide of sodium.

(1109) C. R.—Sciatica cress is a name invented by Turner (an English herbalist of the 16th century) for a cruciferous plant supposed, from his description, to be a species of *Lepidium* (pepper grass). As for Solomon's seal, that is the popular name of several species of the genus *Polygonatum*.

(1110) H. F. asks (1) a good receipt for an insect poison, something that will really exterminate. Have tried Paris green and a host of other things, but they do not seem to take hold of them. A. Use Persian powder, also try powdered borax, or decoction of poke root mixed with molasses. 2. How to treat sheets of

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mica so I can reduce it to a fine powder. A. Grind it in a mortar. 3. What is the dead oil you refer to in your recipe for making roof paint with coal tar? A. It is a product of coal tar distillation. Apply to a coal tar factory.

(1111) A. M. C. asks what the process is for dyeing pearl buttons the different fast colors so the dye will not rub off. A. Wash with lukewarm solution of potash, then place in a strong aqueous solution of the desired color and let them stand, with frequent stirring, in a warm place. To cause the color to penetrate, an immersion of two weeks may be needed. Use the aniline colors.

(1112) F. F. S. asks (1) for good formulæ as cheap as practicable for colored chemical fire-red, white, green. A. Mix 1 part of shellac with 4 parts of nitrate. For green, use nitrate of barium, for red, nitrate of strontium, for white with a violet tinge, use 3 parts chlorate of potash. In the first two mixtures a portion of the nitrate may be replaced by chlorate of potash. 2. Will not a rifle ball, fired perpendicularly, return with velocity and striking force equal to that at the muzzle of the gun at firing? A. It will not, owing to the resistance of the air. In a vacuum it would.

(1113) G. B. S. asks for a receipt for making a liquid stenciling fluid, both black and white. A. Printer's or lithographer's ink thinned with turpentine may be used. Or try the following: *a* Rub together 1 part lampblack and 2 parts Prussian blue with a little glycerine, add 3 parts gum arabic. This will be liable to be affected by moisture. *b*. Dissolve 2 parts borax and 4 parts shellac in 36 parts water by boiling, dissolve 2 parts gum arabic in 4 parts water. Filter first solution and mix with the second. Stir in indigo, or lampblack or both, until proper consistency is attained. This is cheap and comparatively permanent.

(1114) D. M. K. writes: I have a boxwood flute which I wish to stain black like ebony. What is the best stain to use? I want a stain that will not come off or crack as shellac does. A. Boil 1 pound logwood chips or dust in 4 quarts water, add a double handful walnut husks, boil a second time and remove the chips, add 1 pint vinegar and it is ready for application. Apply hot, and follow, after the wood has dried, with a hot solution of copperas, 1 ounce to the quart.

(1115) O. S. F. writes: I have a number of coins which have lain embedded in the soil at Jerusalem until a thick hard coating has been formed about them. Is there any acid, or preparation of any kind, that will soften this coating without eating the bronze and injuring the coin? It is difficult to cut the coating with a knife. A. You must experiment, as the nature of the soil would make a difference in the treatment. Try boiling with water, or heating with vinegar or dilute sulphuric acid.

(1116) R. O. writes for a practical process for home use and in small quantity, for condensing or preserving skimmed milk. We buy wholesale at 5 cents, five gallons pure, country railroad milk. Cannot get less in the neigborhood, or keep it over two days. A. Use an ice box for preservation of your milk. You cannot successfully or practically condense it. Wash and scald all receptacles to be used for it, and keep them closely covered. Possibly the milk has begun to sour before you get it, in which case your task will be harder. A little bicarbonate of soda may be tried stirred into it as a preservative.

(1117) J. J. asks how to split sheets of of paper when they are printed on both sides. A. The paper is firmly glued to two pieces of strong cloth one on each side, and is allowed to dry. Then on pulling them apart the paper will split. The pieces are then removed by soaking. Sometimes two pieces of glassware recommended instead of the cloth. Practice is necessary to determine the conditions for success, as regards quality and strength of glue and other details.

(1118) A. D. asks how to remove oil paint stains, varnish, and tar spots from different kinds of cloth. A. See answer to following query. Also see SCIENTIFIC AMERICAN SUPPLEMENT, No. 158.

(1119) A Reader asks: 1. Will you please publish a formula for making sticky fly paper? A. We have recently published this. If raw linseed oil 3½ ounces is melted with resin 1 pound and molasses 3½ ounces, a very good paper will be obtained. 2. Also how can I take grease spots out of pantaloons, coats, etc.? A. Use benzine or chloroform. First apply it in a circle all around the spot without touching the latter, then sponge off the spot with fresh benzine or chloroform. Never put it directly on the spot or you will produce a ring-shaped stain.

(1120) W. D. asks in reference to production of cold: 1. What is the effect of nitrate of ammonia on iron piping? A. It has but little effect in producing rust or corrosion. 2. Is there any smell therefrom or any gas generated? A. No. 3. Will this solution produce a lower temperature in a given space than can be obtained from ice and salt? A. Yes; if the water is cold to begin with. 4. How long will this solution last without replenishing? A. It depends on the demands made upon it, on the insulating or non-conductive nature of the vessels, and on similar factors. 5. How much nitrate of ammonia would be required with 400 gallons of water? A. About 1,500 pounds.

(1121) C. S. N. writes: I purchased some nitrate of ammonia and dissolved it in a small quantity of water, but it did not make the water any cooler. Can you tell me, through your paper, the reason? A. You probably did not use enough nitrate of ammonia. Use about one-half the weight of the water. It cannot be introduced directly into the water intended for consumption.

(1122) E. J. F. asks: 1. Where, in the West, is the best school for becoming a thorough machinist, and other particulars about such school? A. The University of Michigan, Ann Arbor, Mich., has a four years' course in mechanical engineering. For particulars address the University, asking for catalogue and circulars. Also address Purdue University, Lafayette, Ind., and University of Notre Dame, Notre Dame, Ind. The first named probably stands the highest in general reputation. 2. How is the size of a shot-gun determined, *i. e.*, what regulates the size of the bore, or is it arbitrary? A. It is based on the size of a spherical leaden bullet that would fit the bore. Thus, a number 8 gun means that a spherical bullet of 8 to the pound would do this. Of course, on account of choke boring, etc., the rule is not absolute. 3. If water power is greater at night than in daytime, as some claim, might it not be due to the sun's acting in a direction most favorable in the night? A. It is not greater; therefore the need for a theory does not exist.

(1123) C. T. M. asks: Which metal expands most, gold, silver, copper, brass, German silver, aluminum, platinum, for the same change in temperature? A. For one degree Centigrade the following are coefficients of linear expansion:

Aluminum	0·0000222
Silver	0·0000191 to 0·0000212
Nickel	0·0000128
Copper	0·0000167 to 0·0000178
Zinc	0·0000220 to 0·0000292
Brass	0·0000178 to 0·0000193
Platinum	0·0000088

We can give no reliable figure for German silver, which is an alloy of copper, nickel, and zinc.

(1124) F. T. asks: Can you cite me an authority on wells; the construction, and how best to keep, clean and sweet for drinking purposes? A. Cleanliness is the one rule. The brick or stone lining should be smooth and tight and should be carried a foot or more above the ground, so as to exclude toads, etc. If a pump is used, the top should be covered with a heavy cover, a flagstone being the best. This involves difficulty of access; so it is well to have the cover in sections for easier removal. Occasionally when the water is at its lowest it should be cleaned out. Lower a lighted candle into it before descending so as to test for carbonic acid gas. If the candle is extinguished a descent into the well will be fatal. Milk of lime freshly made may be thrown in along the walls until the gas disappears.

(1125) H. M. writes for a receipt for making a good paste for pasting labels on wood. A. Use freshly made solution of gum tragacanth. Paste made from rye flour and water should answer every purpose. Just enough oil of cloves may be added to give it a perfume; this last addition will check fermentation.

(1126) G. W. G. asks how a bolt of lightning is formed in the clouds. What the temperature of rain clouds are, and their distance from sea level and their composition, if it is uncombined water vapor, or if there are uncombined oxygen and hydrogen in them mixed but uncombined. Can you inform me of an institution that would recognize such inquiries as I propose above and give me replies? A. Lightning is due to the disturbance of the electrical equilibrium. Its origin is unknown. Clouds are composed of little vesicles of water; their temperature and altitude vary. The secretary of the Smithsonian Institution may be addressed for such information. Also the departments at Washington often answer queries in their peculiar lines. We suggest study and reading on your own part.

(1127) H. D. C. asks: Could you explain to me the reason why the rim of a wheel goes around the hub, and also how I could prove the same? A. For discussion of the "wagon wheel problem" and the "squirrel problem" we refer you to SCIENTIFIC AMERICAN SUPPLEMENT, No. 706.

(1128) E. K. asks: What paste or mucilage should I use to line a guitar box with plush? Something that will not go through plush and hold well to wood. A. Use rye flour paste (see query 1023), adding to it about ¼ the weight of the flour of good glue. As your paste is for immediate use, there is no need of adding alum, gum dextrine, or any preservative.

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July 16, 1889,

AND EACH BEARING THAT DATE.

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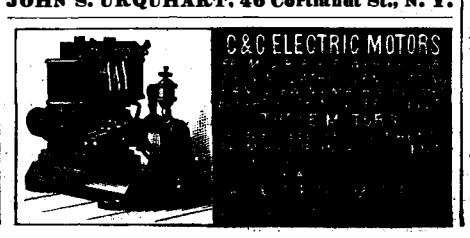

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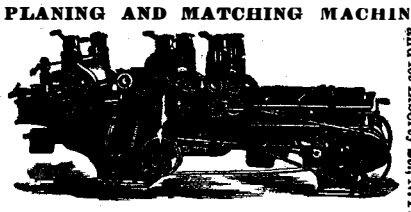

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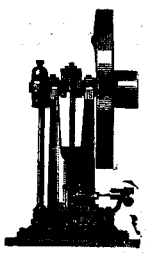

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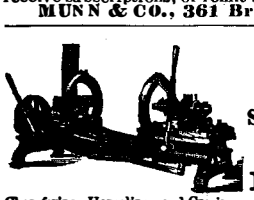

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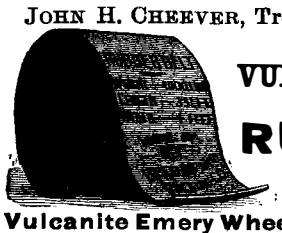

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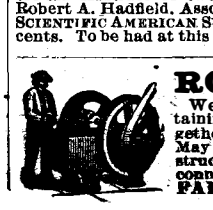

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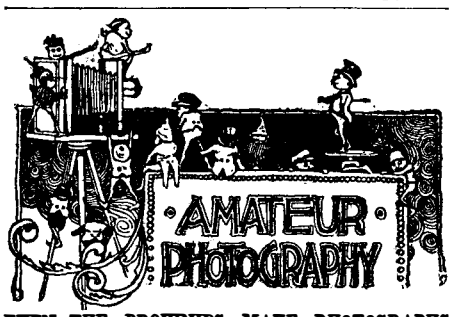

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United States Engineer Office, Savannah, Ga., *July* 13, 1889.—Sealed proposals, in triplicate, will be received at this office until 12 o'clock M., city time, on the 15th day of August, 1889, for removing, repairing, and constructing Wing Dams and Shore Protection in the Savannah River, below Augusta, Ga. Amount available about $6,000. Attention is invited to Acts of Congress, approved February 26, 1885, and February 23, 1887, vol. 23, page 332, and vol. 24, page 414, Statutes at Large. For all necessary information, apply to
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Proposals for Construction of Abutment of Dam No. 1, Cumberland River.—ENGINEER OFFICE, U. S. ARMY, Nashville, Tenn., *July* 5, 1889.—Sealed proposals, in triplicate, will be received at this office until 11 A. M., Tuesday, August 6, 1889, for Building Coffer-dam, Excavating for Foundation, and Construction of Stone Abutment at Dam No. 1, Cumberland River, near Nashville, Tennessee. Bidders are invited to be present at opening of the bids. The United States reserves the right to reject any and all proposals. The attention of bidders is invited to the Acts of Congress approved February 26, 1885, and February 23, 1887, vol. 23, page 332, and vol. 24, page 414, Statutes at Large. Specifications and blank forms for proposals will be furnished on application at this office.
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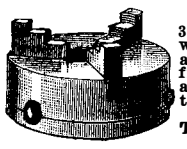

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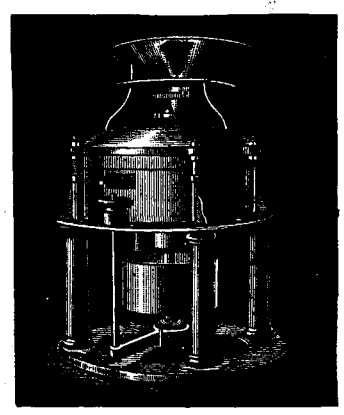

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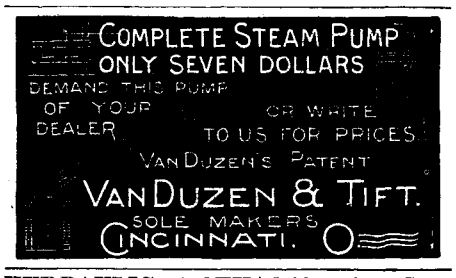

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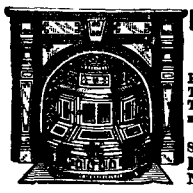

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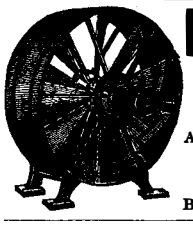

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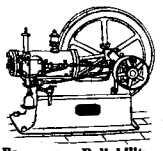

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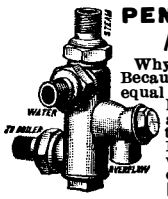

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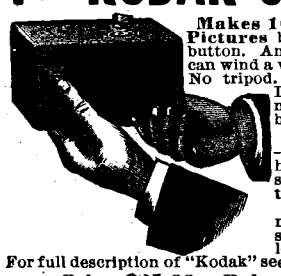

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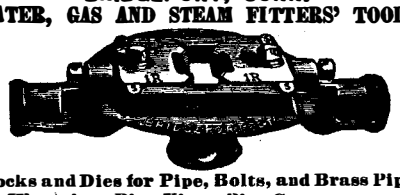

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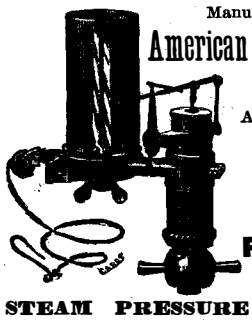

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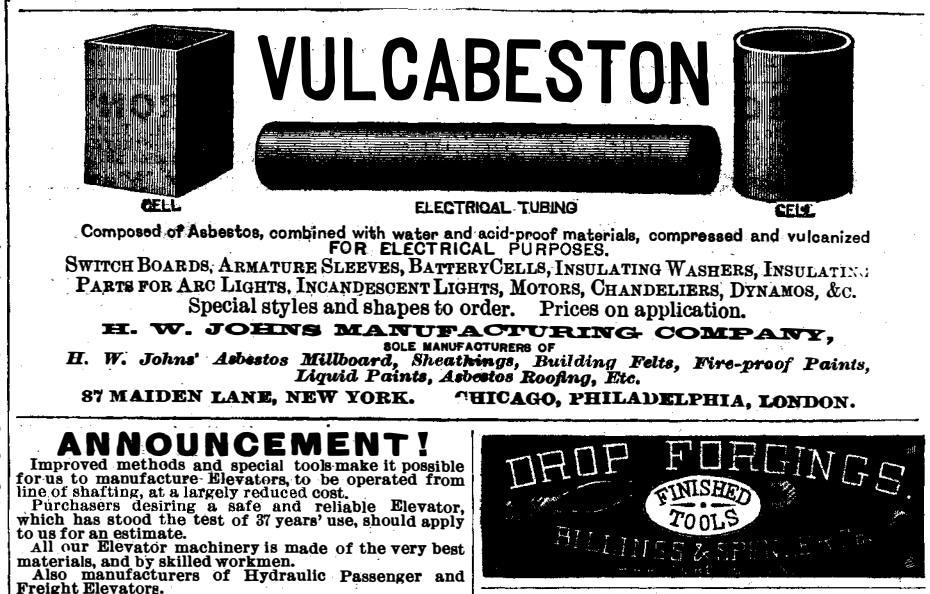

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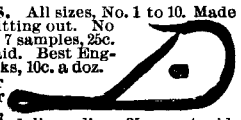

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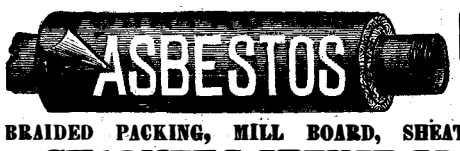

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